गोंय विद्यापीठ
ताळगांव पठार,
गोंय – ४०३ २०६
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GU/Acad –PG/BoS -NEP/2025/257 Date: 21.07.2025

CIRCULAR

In continuation to the Circular No. GU/Acad –PG/BoS -NEP/2024/507 dated: 12.09.2024, the syllabus for Semester III & IV of the **Bachelor of Engineering in Mechanical Engineering** Programme approved by the Standing Committee of the Academic Council in its meeting held on 24th and 25th June 2025 is attached.

The Dean, Faculty of Engineering and Principals of affiliated Colleges offering the **Bachelor of Engineering in Mechanical Engineering** Programme are requested to take note of the above and bring the contents of the Circular to the notice of all concerned.

ASHWIN VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2025.07.21 17:14:17 +05'30'

(Ashwin V. Lawande)
Deputy Registrar – Academic

To,

1. The Dean, Faculty of Engineering, Goa University.
2. The Principals of affiliated Engineering Colleges.

Copy to,

1. The Director, Directorate of Technical Education, Govt. of Goa
2. The Chairperson, BoS in Mechanical Engineering.
3. The Controller of Examinations, Goa University.
4. The Assistant Registrar, Prof. Examinations (Technical and Allied), Goa University.
5. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

MECHANICAL ENGINEERING SCHEME AY 2024-25

SEMESTER - III							
Sr. No.	**Course Category**	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**TCr**
1	**Major**	**MEC-200**	Strength of Materials	3	0	0	3
		MEC-201	Strength of Materials Lab	0	0	1	1
		MEC-202	Engineering Thermodynamics	3	1	0	4
2	**Minor/IC/ PE**	**MEC-221**	Electrical Drives & Instrumentation	3	0	0	3
		MEC-222	Electrical Drives & Instrumentation Lab	0	0	1	1
		OR					
		MEC-223	Digital Electronics & Microcontroller Applications	3	0	0	3
		MEC-224	Digital Electronics & Microcontroller Applications Lab	0	0	1	1
3	**Multi-disciplinary**	**SHM-232**	Applied Mathematics - II	3	0	0	3
4	**AEC**	**AEC-251**	*	0	0	2	2
5	**SEC**	**MEC-241**	Machine Drawing & Machining Processes Lab	0	0	3	3
			TOTAL	**12**	**1**	**7**	**20**

** AEC Courses shall be notified by the University based on the recommendations of respective Board of Studies in languages.*

Approved by: Standing Committee of the Academic Council on 24th & 25th June 2025

SEMESTER - IV							
Sr. No.	**Course Category**	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**TCr**
1	**Major**	**MEC-203**	Fluid Mechanics	3	0	0	3
		MEC-204	Fluid Mechanics Lab	0	0	1	1
		MEC-205	Kinematics of Machines	3	0	0	3
		MEC-206	Kinematics of Machines Lab	0	0	1	1
		MEC-207	Internal Combustion Engines	2	0	0	2
		MEC-208	Internal Combustion Engines Lab	0	0	2	2
		MEC-209	Manufacturing Technology - I	3	0	0	3
		MEC-210	Manufacturing Technology - I Lab	0	0	1	1
2	**Professional Elective**	**MEC-225**	Numerical Methods & Computer Programming	3	0	0	3
		MEC-226	Numerical Methods & Computer Programming Lab	0	0	1	1
		OR					
		MEC-227	Alternate Energy Sources	3	0	0	3
		MEC-228	Alternate Energy Sources Lab	0	0	1	1
		OR					
		MEC-229	Fundamentals of Turbo Machines	3	0	0	3
		MEC-230	Fundamentals of Turbo Machines Lab	0	0	1	1
			TOTAL	**14**	**0**	**6**	**20**

SEMESTER III

Major Courses

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-200
Title of the Course : Strength of Materials
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the course:	Nil	
Course Objectives:	**The course will enable students to:** 1. To identify stress, strain and deformation due to external loads. 2. To perform two dimensional stress and strain analysis. 3. To understand the behavioural response of beams, struts, columns and trusses to forces. 4. To apply various failure theories and energy methods.	
Content:		**No of hours**
Unit - 1	**Introduction:** Review of engineering mechanics, static analysis of rigid systems. Introduction to Stress and Strain. Hooke's law, Poisson's ratio, Generalized Hooke's law, modulus of rigidity, bulk modulus, relation between material constants. **Uniaxial Deformation:** Uniaxial tension and compression, temperature stresses, statically indeterminate systems. **Two Dimensional Stress and Strain Analysis:** Analysis of two dimensional stress and strain, stress and strain analysis using Mohr's circle, strain gauge rosettes.	**10**
Unit - 2	**Properties of Areas:** Review of Moments of inertia and polar moment of Inertia, Product of inertia, Principal axes, Principal moments of inertia, Mohr's circle for Moment of Inertia. **Beams:** Bending moment and shear force in beams, relation between them, sign convention, Bending stresses in beams-Flexure formula, Shear stresses in beams, deflection of beams (using double integration method, singularity functions method).	**11**
Unit - 3	**Torsion:** Torsion of solid and hollow circular shafts. **Theories of Failure & combined loading:** Various theories of failures and their limitations comparison and applications. Combined Loading: Shafts subjected to bending moment and twisting moment, members subjected to bending and direct tension/ compression	**12**
Unit - 4	**Struts and Columns:** Struts and core of section, stability of columns, Euler's critical load, for different end conditions of column, empirical formulae for buckling load. **Energy Methods:** Introduction strain energy equations for	**12**

	different loading conditions, Maxwell- Betti reciprocal theorem, Castigliano's 1 st theorem, applications of Castiglianos 1st theorem for statically determinate structures **Thick and Thin Cylinders:** Thin cylinders subjected to internal pressure, thick cylinders, Lame's equation.	
Pedagogy:	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Textbooks** 1. S. Ramamrutham; Strength of Materials; 16th Edition, Dhanpat Rai Publishing Co. (P) Ltd., 2012. ISBN-13: 9788189401269 2. S. S. Bhavikatti; Strength of Materials; 4th Edition, Vikas Publishing House Pvt Ltd., 2013. ISBN-13: 978-9325971578 3. S. P. Timoshenko, D. H. Young; Elements of Strength of Materials, 6th Edition, East West., 2003. ISBN-13: 978-1124155098 **References** 1. Beer Ferdinand, Johnson E. Russel; Mechanics of Materials, 5th Edition, McGraw Hill Books., 2009 ISBN-13: 978-0070153899 2. R. K. Bansal; A Textbook of Strength of Materials, 6th Edition, Laxmi Publications, 2015. ISBN: 978-8131808146 3. B.S. Basavarajaiah, P.Mahadevappa; Strength of Materials; 3rd Edition, University Press (India) Pvt. Ltd., 2010 ISBN13: 9788173714580	
Course Outcomes:	CO 1. Understand the basic concepts of Stress, Strain, Moment of Inertia, Shear Force and Bending Moment Diagram, Theories of Failure and Energy Methods. CO 2. Apply the knowledge of Stress, Strain, Moment of Inertia, Pure Torsion, bending of beams, Theories of Failure & Energy Methods. CO 3. Analyze structural members and machine elements subjected to axial loads, lateral loads, bending and twisting moments for stresses, strains, and displacements and analyze statically determinate structures using Energy methods CO 4. Evaluate the basic relations for Stress, Strain, Moment of Inertia, Pure Torsion, bending of beams, Theories of Failure & Energy Methods.	

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-201**
Title of the Course : **Strength of Materials Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the course:	Nil	
Course Objectives:	**The course will enable students to:** 1. To develop an understanding of material behavior under different loading conditions through experimental testing of mechanical properties 2. To develop skills in performing standard material testing methods using Universal Testing Machine (UTM), fatigue test machine, impact testing machines, and torsion test apparatus. 3. To enable students to correlate theoretical concepts with practical observations by conducting experiments on Mohr's Circle, truss analysis, and elastic constant determination.	
Content:	**LIST OF EXPERIMENTS**	**No. of Hours**
	1. Conduct of Tensile test on mild steel on Universal Testing Machine (UTM) and determine its behaviour under tensile loading. 2. To find the shear strength of a given material using UTM. 3. To perform Charpy impact test on a given material. 4. To determine the Impact strength. (Specific impact factor) through Izod test. 5. To determine the flexural strength of a beam. (3-point loading of beam) 6. To determine a material's fatigue behavior by using Fatigue test machine. 7. To conduct torsion test on mild steel specimen to find modulus of rigidity or to find angle of twist of the materials 8. To determine the elastic constant (modulus of elasticity) of a cantilever beam subjected to concentrated end load by using strain gauges. (Electrical resistance strain gauges) 9. Verification of Mohr's Circle. (Comparing analytical and graphical methods) 10. To perform the analysis of simple truss.	**30**
Pedagogy:	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	

Course Outcomes:	CO 1. Understand the mechanical performance of materials and correlate experimental results with theoretical concepts in materials science CO 2. Apply theoretical knowledge to solve real-world problems in material testing and structural analysis, while developing the skills needed to interpret experimental data effectively. CO 3. Analyze proficiency in using testing machines, recording data, and analyzing material responses to different forces and conditions. CO 4. Evaluate the mechanical performance of materials and correlate experimental results with theoretical concepts in materials science

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-202**
Title of the Course : **Engineering Thermodynamics**
Number of credits : **4**
Effective from AY : **2024-25**

Pre-requisites for the course:	Nil	
Course Objectives:	1. Impart knowledge on the basics of thermodynamic laws, properties of substance and air standard cycles. 2. Comprehend the laws of thermodynamics in analysing the performance of thermal devices. 3. Familiarize with the behaviour of pure substance with the help of property diagrams and achieve various properties of steam through steam tables and Mollier chart. 4. To understand the principles of various cycles and to apply the thermodynamic concepts in applications like IC engines and air conditioning system.	
Content:	**Topics**	**No. of Hours**
Unit-1	**First law of thermodynamics:** Energy of systems, classification of energy, law of conservation of energy, first law applied to closed system undergoing a cycle, Joule experiment, energy-a property of system, internal energy: a function of temperature, enthalpy, specific heat at constant volume and constant pressure, change in internal energy and heat transfer during various non-flow processes. **First law applied to flow processes:** Steady-state steady flow process, mass balance and energy balance in steady flow process, steady flow energy equation and its application to nozzles and diffusers, throttling valve, turbines and compressors, pumps, heat exchangers etc. Work done and heat transfer during steady flow processes.	**15**
Unit-2	**Second law of thermodynamics:** Limitations of first law of thermodynamics, heat engines, refrigerators and heat pumps, Kelvin-plank and Clausius statements, their equivalence, reversible and irreversible processes, factors that render processes irreversible, Carnot cycle, two propositions regarding the efficiency of Carnot cycles, the thermodynamic temperature scale, reversed Carnot cycle, COP of heat pump and refrigeration. **Entropy:** Inequality of Clausius, entropy: a property of system, temperature entropy plane, entropy change for ideal gases, entropy change of a system during irreversible process, lost work, entropy generation-application, principle of increase of entropy.	**15**
Unit-3	**Properties of pure substance:** Steam formation and its	**15**

	thermodynamic properties, P-V, P-T diagram, T-S diagram of pure substance, h-s diagram or Mollier chart, P-V-T surface, Quality or Dryness Fraction, Steam tables – Reading and use of various tables & calculations, Determination of steam quality. **Vapor power cycles:** Simple steam power cycle, Basic Rankine cycle with derivation, mean temperature of heat addition, Work ratio, steam rate, heat rate, representation on P-v, T-s diagram, derivation and calculation on simple rankine cycle.	
Unit-4	**Air standard cycles:** Assumption made for air standard cycles, Overview of reciprocating engines, Air standard cycles for reciprocating engines – Otto, Diesel & Dual, Criteria for comparison & comparative analysis, Derivation for efficiency, Mean effective pressure (MEP) and Problems. **Brayton Cycle:** Ideal cycle for gas turbine engines, Deviation of actual cycle, Enhancement – with regeneration, reheating and intercooling. Derivation & calculation on simple brayton cycle.	**15**
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books** 1. Y. A. Cengel, M. A. Boles; Thermodynamics – An Engineering Approach; 3rd Edition, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 1998. ISBN-13: 978-0073963259 2. P. K Nag; Engineering Thermodynamics; 2nd Edition, Tata McGraw Hill Education Pvt. Ltd.; New Delhi, 1992ISBN-13: 978-0070260627 **Reference Books** 1. E. Radhakrishna; Fundamentals of Engineering Thermodynamics, 3rd Edition; Prentice Hall of India Pvt. Ltd., New Delhi, 2005. ISBN-13: 978-8120327900 2. J. B. Jones, R. E. Dungan; Engineering Thermodynamics; 7th Edition, Prentice Hall of India Pvt. Ltd., New Delhi. 1995 ISBN-13: 978-0023613326 3. G. V. Wylen; R. Sonntag, C. Borgnakke; Fundamentals of Classical Thermodynamics; 7th Edition , John Wiley & Sons, 2016. ISBN-13: 978-0471593959	
Course Outcome:	CO 1. Remember and understand the basic concepts, properties, processes, relations, laws, and formulae of thermodynamics, pure substance, heat engines and energy conversion cycles. CO 2. Understand the basic concepts, properties, processes, relations, thermodynamic laws, derivations, diagrams, charts and tables of thermodynamic systems, pure substance, heat engines and basic energy conversion cycles. CO 3. Apply the thermodynamic laws, properties of pure substances, and thermodynamic power cycles to various applications in engineering and real life. CO 4. Analyze the various problems associated with the thermodynamic laws, properties of pure substances, and thermodynamic power	

	cycles in engineering and real life.

Minor/IC/PE

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-221
Title of the Course : Electrical Drives & Instrumentation
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of electromagnetic induction and basic electronics concepts.	
Course Objectives	1. An understanding of construction and working of DC and AC motors. 2. An understanding of methods used for starting, braking and speed control of AC and DC motors 3. An introduction to the drive system and its characteristics. 4. An introduction to the transducers and switching devices	
Content:	Topics	**No. of Hours**
Unit-1	**D.C. Generator:** Working principle, construction, e.m.f. equation, types of generators, their voltage & current equations **D.C. Motor:** Working principle, concept of back e.m.f., torque equation, speed (Illustrative Examples). Classification of d.c. motors, electrical & mechanical characteristics of d.c. motors, speed control of dc shunt and series motor (Illustrative Examples). Power flow diagram & different types of losses, Necessity of a Starter.	**12**
Unit-2	**Three phase induction motor:** working principle, construction, slip, starting torque, torque under running condition, torque-slip characteristics (Illustrative Examples). Power flow diagram, efficiency. Starting of 3-phase Induction Motor - types of starters, their circuit diagram, working and application, methods used in speed control. **Single phase induction motor:** Split-Phase types only their circuit diagram & working, torque slip characteristics.	**12**
Unit-3	**Special Purpose Machines:** **Brushless DC motor**: Construction, operation & application. **Servomotor:** Types, construction and operation. **Stepper Motor:** Types, construction and operation. **Electric Drives:** Concept of electric drive, four quadrant diagram of speed torque characteristics, classification of drives & their application. Electric braking of d.c. motors.	**10**
Unit-4	**Transducers:** **Displacement Transducer:** Basic displacement measurement scheme, different types of displacement transducers: strain gauge, linear variable differential transformer, Piezoelectric, Potentiometer. **Velocity Transducers:** Basic principle of measuring velocity, Tachogenerator, Stroboscopic method of measuring rpm	**11**

	(revolutions/minute) **Pressure Transducers:** Inductive, resistive and capacitive transducers for measuring pressure. **Temperature Transducers:** Resistance Temperature Detector (RTD) and Thermistors. **Switching Devices:** Contactors- Electro magnetic type only, Bimetallic (over current / thermal) relay- construction & working. **Circuit Breakers:** MCB, MCCB & ELCB – block diagram, working, specifications & applications.	
Pedagogy:	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/Readings:	**Text Books** 1. B. L. Theraja, A. K.Theraja, A Textbook of Electrical Technology Volume II,, 23rd Edition, S. Chand Publication, 2005, ISBN-10; 8121924375 2. V. K. Mehta, Rohit Mehta, Principles of Electrical Machines, 2nd Edition S. Chand Publication, 2019, ISBN-13: 9788121921916 3. S K Pillai, A First course on Electrical Drives, New Age International (P) Ltd. 3rd Edition, ISBN-10. 8122433618 **Reference Books** 1. Helfrick & Cooper, Modern Electronic instrumentation & Measurement, 1st Edition, Prentice Hall of India, 2008. ISBN-13: 9788120307520 2. J.B.Gupta, A First Course in Electronics & Electrical Measurement and Instrumentation, 14th Edition S.K.Kataria & Sons, 2014. ISBN-10: 8188458937	
Course Outcomes:	CO 1. Understand the construction and working of DC, AC and special purpose machines, electric drives and switching devices. CO 2. Describe braking methods of DC motors and operation of transducers. CO 3. Analyse the speed control methods of dc motor. CO 4. Evaluate the performance characteristics of DC motor and 3-phase induction motor.	

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-222**
Title of the Course : **Electrical Drives & Instrumentation Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Prerequisites for the Course:	Concepts of DC and AC motor working, performance characteristics and speed control. Knowledge basic computer programming	
Course Objectives	This course will enable students to: 1. Understand the construction and working of DC, servo, and stepper motors. 2. Learn motor control techniques and electric braking methods for DC motors. 3. Use simulation software for transducer applications and motor control. 4. Analyze performance characteristics of DC and induction motors.	
Content:	**List of Expriments**	**No. of Hours**
	1. To perform Speed Control of DC motor by Flux control and Armature voltage control methods. 2. To Perform Load Test on 3-Phase Induction Motor and plot the performance characteristics 3. To study the operation of Permanent Magnet Stepper Motor 4. Determination of unknown resistance using Wheatstone's Bridge 5. Determination of emf of an unknown cell using Slide wire potentiometer 6. Implementation and performance evaluation of LVDT Transducer/ temperature transducer 7. Implementation and performance evaluation of Potentiometric transducer / Strain Guage measurement. 8. Simulation of speed control strategies of Brushless DC Motor 9. To develop program to plot Torque-Slip/ Torque-Speed characteristics of 3-phase Induction motor. 10. LabVIEW based electrical and electronic measurements.	**30**
Pedagogy:	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
Course Outcomes	CO 1. Understand the construction and working of DC, AC and special purpose machines, electric drives and switching devices. CO 2. Describe braking methods of DC motors and operation of transducers. CO 3. Analyse the speed control methods of dc motor. CO 4. Evaluate the performance characteristics of DC motor and 3-phase	

	induction motor.

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-223**
Title of the Course : **Digital Electronics & Microcontroller Applications**
Number of Credits : **3**
Effective from AY : **2024-25**

Pre-requisites for the course	Basics of Electronics Engineering	
Course Objectives	1. To enable students to understand the working principles of basic digital electronic circuits and microprocessor-based systems 2. To develop an understanding of electronic control mechanisms used in mechanical systems. 3. To prepare students for advanced courses such as Mechatronics and Fluid Power Control by building foundational knowledge in electronic and control systems.	
Content	Topics	**No. of Hours**
Unit-1	**Number Systems:** Introduction to Decimal, Binary, & Hexadecimal number systems. Logic Gates and their truth Tables. **Study of Boolean Algebra**: Axioms, Laws& theorems of Boolean algebra, Reducing Boolean Expressions, Converting AOI to NAND/NOR Logic, Sum of products form (SOP), products of sum form (POS) of Boolean functions. **Study of Karnaugh Maps (K-maps):** for 2, 3 & 4 variables only. Don't Care conditions.	**11**
Unit-2	**Combinational Logic:** Half Adder, Half Subtractor, Full Adder, Full subtractor, Encoders and Decoders; Multiplexers and Demultiplexers. **Study of Flip Flops:** Study of clocked RS flipflop, JK- flip flop, T-flip flop, D- flip flop. **Motors:** Construction and Working of DC Motors, AC Induction Motors, Stepper motors.	**12**
Unit-3	**8051 Architecture:** Introduction, 8051 Microcontroller Hardware: 8051 Oscillator and clock, Program counter and data pointer, A and B CPU register, Flags and PSW, Internal Memory, Internal RAM, Stack and Stack Pointer, Internal ROM. **Serial communication:** Serial transmission and Reception, SFRs. **Interrupts:** Interrupt SFRs.	**11**
Unit-4	**8051 Timers and Counters:** Timer/Counter SFRs and modes of Operation, Calculating Delay Problem using Timers in mode 1 only. **Interfacing with 8051 based Microcontroller system using Embedded C:** I/O port programming, Interfacing LEDs, LCD, Temperature sensors, Relay, Opto-isolators & Stepper Motors.	**11**

Pedagogy:	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.
References/Readings:	**Text Books** 1. Anand Kumar, "Fundamentals of Digital Circuits", 2nd Edition, PHI Learning Pvt. Ltd. 2016, ISBN:9788120336797 2. Ayala Kenneth J, "The 8051 Microcontroller, Architecture, 3. Programming & applications", 2nd Edition; Penram International, 2014, ISBN:9788184953251 4. Muhammad Ali Mazidi, Janice Gillispie Mazidi; "The 8051 Microcontroller and Embedded systems using Assembly and C"; 2nd Edition, Pearson Education, 2017, ISBN:9788131710265 **Reference Books** 1. Morris Mano M, "Digital Logic & Computer Design", 1st Edition, PHI, India, 1979, ISBN:9789332586048 2. Austin Hughes, Electric Motors and Drives: Fundamentals, Types and Applications, 4th Edition, Elsevier, 2013, ISBN: 978-0-7506-4718-2
Course Outcomes:	CO 1. Understand Number systems, Boolean Algebra, flip-flops, registers and counters. CO 2. Apply the above knowledge to build simple combinational and sequential circuits CO 3. Analyse the architecture of 8051 microcontroller CO 4. Creat 8051 microcontroller program to interface different input and output devices.

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-224**
Title of the Course : **Digital Electronics & Microcontroller Applications Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the course	Basics of Electronics Engineering	
Course Objectives:	1. To provide students with a solid understanding of the concepts and design principles of combinational and sequential circuits. 2. To introduce the fundamentals of microcontrollers and develop students skills in assembly language programming for embedded system applications.	
Contents:		**No. of Hours**
	1. To verify the truth table of Logic Gates/ To verify the truth table of Flip-flops 2. Realization of logic gates using Universal Gates/ of Boolean expressions in SOP & POS forms. 3. Design and verify the truth table of Adders, Code Converters & Subtractors 4. Implementation and verification of Multiplexers & Demultiplexers 5. Implementation and verification of Encoders & Decoders 6. Performance of Shift Registers 7. Using 8051 Microcontroller write a Programs for arithmetic operations – addition, subtraction, multiplication& division 8. Using 8051 Microcontroller write a Programs for block transfer of data 9. Using 8051 Microcontroller write a Programs for sorting the numbers 10. Using 8051 Microcontroller write a Programs for interfacing with switches & LED's	**30**
Pedagogy:	Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments	
Course Outcomes	CO 1. Understand Number systems, Boolean Algebra, flip-flops, registers and counters. CO 2. Apply the above knowledge to build simple combinational and sequential circuits CO 3. Analyse the architecture of 8051 microcontroller CO 4. Create 8051 microcontroller program to interface different input and output devices.	

Multi-disciplinary Courses

Name of the Programme : B.E. Mechanical Engineering
Course Code : SHM-232
Title of the Course : Applied Mathematics II
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the course	Applied Mathemetics I	
Course Objectives	The course is intended at making students understand fundamentals of Mathematics necessary to formulate, solve and analyze engineering problems.	
Content:	**Topics**	**No. of Hours**
Unit-1	**Matrices :** Types of matrices, Determinant, inverse of matrix, Elementary transformations, Elementary matrices, Rank of matrix, Reduction to normal form, Canonical form, Rank using elementary transformation, Linear independence and dependence of vectors, System of the form AX = 0, and AX = B, and their solutions, Eigen values, Eigen vectors with properties, Cayley-Hamilton theorem with its applications, Diagonalization.	**12**
Unit-2	**Laplace Transforms**: Definition. Existence conditions, properties, inverse Laplace transforms. Laplace transform of periodic functions, Convolution theorem, Laplace transform of Dirac-Delta function, Application of Laplace transforms in solving linear differential equations with initial conditions	**12**
Unit-3	**Fourier Series :** Periodic functions, Trigonometric series, Euler's formulae, Dirichlet's condition, Even and odd functions, Half range series, Parseval's identity. Partial Differential Equations: Derivation and solution of one dimensional wave equation using separation of variable method. Derivation and solution of one dimensional heat equation using separation of variable method.	**10**
Unit-4	**Probability:** Definition, properties, Axioms of probability, conditional probability, theorem on total probability, Baye's theorem; Random variables-discrete & continuous; Expectation and Variance, Standard deviation, Moment Generating Function & properties, Standard distributions: discrete-Binomial, Geometric & Poisson; continuous- Uniform, Normal, exponential.	**11**
Pedagogy:	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books** 1. B. S. Grewal; Higher Engineering Mathematics; 43rd Edition Khanna	

	Publications, New Delhi.2014 ISBN-13: 9788174091956 2. Veerarajan; Engineering Mathematics; 17th EditionTata McGraw Hill Publications. 2018, ISBN-13: 9789387432109 3. D. C. Montgomery, G. C. Runger, Applied Statistics and Probability for Engineers; 6th Edition Wiley India, 2016. ISBN: 978-8126562947 **Reference Books** 1. P. Kandasamy; Engineering Mathematics; 6th Edition, Chand & Co., New Delhi 2003. ISBN-13: 9788121911306 2. Srimanta Pal, Subodh C. Bhunia; Engineering Mathematics; 1st Edition, Oxford University Press of India Pvt. Ltd. 2015, ISBN-13: 9780198070894
Course Outcomes:	CO 1. Understand the theory of matrices, Laplace transforms, Fourier Series, Probability theory and the formulation of one-dimensional wave equation, heat flow equation and its solution. CO 2. Apply and compute the rank of matrix, eigen values and eigen vectors of a matrix, Laplace/ inverse transform of functions, Fourier Series of functions and Probability of events. CO 3. Analyze and use rank of a matrix to analyze solutions of linear systems of equations. Solve differential /integral equations using Laplace transforms. Use Fourier series to find the solution of Partial differential equations such as wave equations and heat flow equations. CO 4. Evaluate and model real life problems with matrices, use probability for estimation. Propose a value to be substituted in a Fourier series to obtain the given real number series.

Skill Enhancement Courses

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-241
Title of the Course : Machine Drawing & Machining Process Lab
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the course	Knowledge of fundamentals of Mechanical Engineering	
Course Objectives	1. To develop the ability to visualize mechanical components and represent them accurately through technical drawings, including assembly and disassembly drawings. To interpret geometric representations, dimensional tolerances, and conventional symbols used in production drawings. 2. To understand the selection and application of appropriate tools, materials, and instruments required for various operations in a workshop setting. To gain knowledge of the working principles and operations of machine tools such as lathe, grinding, milling, drilling, and shaping machines.	
Contents:		**No. of Hours**
	Basic of Engineering Drawing: **Preliminaries:** Introduction to machine drawing, conventional representation of machine components, materials, springs & gears, indication of surface texture. **Limits, Fits & Tolerances:** Terms related to dimensional tolerances, Types of tolerances, Systems of dimensional tolerances & fits, Calculation of fundamental deviations and tolerances, Types of fits **GD&T:** Importance, ASME Y14.5, ISO 1101, Feature Control Frame (FCF). Datums – Primary, Secondary, Tertiary References. GD&T Symbols- Form: Straightness, Flatness, Circularity, Cylindricity. Profile: Line, Surface. Orientation: Parallelism, Perpendicularity, Angularity. Location: Position, Concentricity, Symmetry. Runout: Circular, Total. **Modifiers**- MMC, LMC, RFS, Bonus Tolerances. **Introduction to Computer aided drafting software**: Interface – Workspace, toolbars, command line, Drawing Tools, Editing Tools, Layers, Dimensions & Annotations, Viewports & Layouts. **Joints** Threaded Fasteners & joints: Screw thread nomenclature, types of threads, nut, bolt and washer, locking arrangements of nuts, foundation bolts freehand sketches only Keys, Cotters & Pin joints: Keys, cotter joints, socket & pigot joint, sleeve & cotter joints, jib & cotter joint knuckle joint freehand sketches only) Welded joints: Types of welded joints, welding symbols	**20**

	Rivetted joints: Introduction, classification, caulking & fullering for rivets Pipe joints (freehand sketches only) **Power Transmission Units**: Shaft couplings, Shaft bearings (freehand sketches only)	
	Basic of Application of Drawing Concepts: Assembly drawing with sectioning and bill of materials of following: Stuffing Box , Petrol Engine Piston, Lathe tail stock, screw Jack. Note: **At least two assembly drawings** from above list must be performed using any standard drafting software used in industry. Drawing Sheets on details must include dimensional as well as geometrical tolerances and surface finish requirements Part or Disassembly Drawings of following: Single Tool Post, Steam Engine Cross Head, Milling Machine Tail stock, Blow off cock Note: **At least two disassembly drawings** from above list must be performed using any standard drafting software used in industry. Drawing Sheets on details must include dimensional as well as geometrical tolerances and surface finish requirements.	**25**
	Workshop Introduction: 1. Basic safety training including usage of workshop personal protective equipment's and discipline to be observed in workshop **Lathe Turning:** 1. Study of Lathe machine, tools used, various operations performed and process planning 2. One Composite Machine Job made by following operations - Facing, Plain Turning, Step Turning, Taper turning, Center drilling, threading, chamfering	**25**
	Machining: 1. Grinding: Introduction**, t**ypes of Grinding machines, **JOB: Lathe tool Grinding using Pedestal grinder from stock** 2. Milling: Introduction, tools used, different applications of Universal Milling Machine **JOB:** Manufacturing of a hexagonal nut using milling machine and indexing head 3. Shaping machine**:** Introduction, Application and demonstration 4. Drilling machine: Introduction, application and demonstration **Sheet Metal working (SMW):** 1. Introduction to SMW, Identify applications, various operations and tools such as snips, shears etc. used. Two paper models which requires application of development concepts(cuboid tray, Cone or any other shapes)(3hrs) 2. Sheet metal jobs such as tray, Dust pan, Funnel etc made by hand using sheet metal of suitable gauge.	**20**

Pedagogy:	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.
Course Outcomes	CO 1. Understand the use of limits, fits, tolerances, GD&T in production drawings. CO 2. Describe lathe turning knowledge and SMW to machine the stock to required dimensions and to create simple SMW products.Draw assembly and disassembly of various mechanical systems. CO 3. Apply skills on Grinding machine to make a single point cutting tool and working of Milling, Drilling and Shaper. CO 4. Create assembly and disassembly drawing of various mechanical systems.

SEMESTER IV

Major Courses

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-203
Title of the Course : Fluid Mechanics
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of Applied Physics	
Course Objectives:	1. The learning objectives include physical properties of fluids, fluid statics, kinematics and dynamics, 2. To familiarize with the science of fluid flow and its applications. 3. To achieve the basic skills to find out the losses in pipe flow. 4. Conduct dimensional analysis and analyse boundary layer theory	
Content:	**Topics**	**No. of Hours**
Unit-1	**Properties of fluids:** Definition of fluid, Classification and properties of fluids, Surface tension and capillarity, Compressibility and bulk modulus, Newton's law of viscosity, non-Newtonian fluids. **Fluid Statics:** Pascal's law, Pressure variation in a static fluid, Measurement of pressure: Manometers (simple), Differential manometers, Mechanical gauges, hydrostatic force on submerged plane surfaces (no derivations, excluding curved surfaces), buoyancy, stability of submerged & floating bodies (no derivations)	**12**
Unit-2	**Fluid Kinematics & Dynamics:** Types of fluid flow, Discharge, continuity equation, Continuity equation in 3D, Equations of motion, Euler's equation, Bernoulli's equation, Practical application of Bernoulli's equation (only venturimeter and orificemeter, No derivations), Impulse momentum equation, Kinetic energy and momentum correction factor (only theory). **Flow through Pipes:** Loss of head in pipes, major, minor losses (No derivations), Darcy-Weisbach equation, Hydraulic gradient and total energy line, Flow through siphon, Equivalent pipe - series & parallel pipes.	**12**
Unit-3	**Viscous Flow:** Introduction, Reynold's experiment, Flow of viscous fluid through circular pipe Hagen-Poiseuille formula (only derivation), Flow of viscous fluid between two parallel plates (only derivation). **Dimensional Analysis:** Need for dimensional analysis, Dimensions of physical properties, Dimensional homogeneity, Buckingham's pi theorem, Rayleigh's method, Model analysis:	**10**

	Similitude, Forces in hydraulic phenomena, Important dimensionless numbers and their significance, Similarity laws: Reynolds model law (Numericals)	
Unit-4	**Boundary Layer flow:** Laminar and turbulent boundary, Laminar sub-layer, Boundary layer thickness, Energy thickness and momentum thickness, Drag force on a flat plate due to boundary layer, Total drag due to laminar and turbulent layers, Boundary layer separation and its control. **Flow Around Submerged Bodies - Drag and Lift:** Forces exerted by a flowing fluid on a body, expressions for drag and lift force coefficients (formulae, concept and applications, no derivations), Types of drag forces: Pressure drag and friction drag (theory only for flat plate, No sphere and cylinder), Numericals on calculations of lift and drag forces on simple bodies.	**11**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/Readings:	**Text Books** 1. R. K. Bansal; A textbook of Fluid Mechanics & Hydraulic machines; 11th Edition, Laxmi Publications (p) Ltd; 2017. ISBN-13: 978-8131808153 2. Y. A. Cengel, J. M. Cimbala; Fluid Mechanics: Fundamentals & Applications; 4th Edition, McGraw-Hill Education , New Delhi; 2019, ISBN-13: 978-0071284219 **Reference Books** 1. R. W. Fox, P. J. Pritchard, A. T. McDonald; Introduction to Fluid Mechanics; 7th Edition, Wiley India; 2008. ISBN-13: 978-0471742999 2. P. N. Modi, S. M. Seth; Hydraulics & Fluid Mechanics including Hydraulic Machines; 14th Edition, Standard Book House, New Delhi; 2009. ISBN-13: 978-8189401269	
Course Outcomes:	CO 1. Remember the basic concepts, definitions, properties, processes, laws, relations, and formulae of Fluid Mechanics. CO 2. Understand the principles, laws and governing equations of fluid statics, kinematics and dynamics. CO 3. Apply the knowledge of Fluid Mechanics to various applications in engineering and real life. CO 4. Analyse the various problems associated with Fluid Mechanics in engineering and real life.	

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-204**
Title of the Course : **Fluid Mechanics Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Prerequisites for the Course:	Knowledge of Applied Physics	
Course Objectives	1. Explain fundamental fluid mechanics principles such as Bernoulli's theorem, continuity equation, and energy losses in fluid flow 2. Conduct experiments to measure velocity, pressure, discharge, and energy losses in different fluid flow scenarios, and interpret the results. 3. Compare experimental results with theoretical predictions to evaluate the accuracy of fluid mechanics principles and identify potential sources of error. Evaluate performance of fluid flow systems such as pipes, and flow meters.	
Content:	**List of Experiments**	**No. of Hours**
	1. Verification of Bernoulli's Theorem 2. To determine the coefficient of discharge of a venturimeter 3. To determine the coefficient of discharge of an orifice meter 4. To determine the coefficient of discharge of a mouthpiece 5. To determine the coefficient of discharge of a V-notch 6. To determine the coefficient of discharge of a Rectangular-notch 7. To calculate friction factor in Helical coil 8. To determine the coefficient of friction in pipe set-up 9. To find minor losses in pipes 10. To determine the coefficient of discharge of a flow nozzle	**30**
Pedagogy:	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
Course Outcomes	CO 1. Understand the fundamental principles of fluid flow and related phenomena through experimental validation. CO 2. Describe experiments to measure fluid flow parameters like velocity, pressure, discharge, and energy losses using appropriate instruments CO 3. Evaluate the performance and discharge characteristics of various fluid measurement devices. CO 4. Analyze energy losses in fluid flow through pipes and fittings and assess frictional losses in different systems.	

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-205**
Title of the Course : **Kinematics of Machines**
Number of Credits : **3**
Effective from AY : **2024-25**

Prerequisites for the Course:	Knowledge of Applied Physics, Applied Mechanics	
Course Objectives:	1. To introduce students to the fundamental concepts of mechanisms, machine elements, and mechanical motion. 2. To analyze the motion of linkages, cams, gears, and other machine components. 3. To understand the working and analysis of gear trains, belt drives, and other mechanical power transmission devices. 4. To enhance students' ability to apply theoretical concepts to analyze and design machine elements.	
Content:	Topics	**No. of Hours**
Unit-1	**Classification of Mechanisms:** Basic kinematic concepts and definitions, Degree of freedom, Mobility, Kutzbach's criterion, Gruebler's criterion, Grashof's Law, Kinematic inversions of four-bar chain, slider crank chain double slider chain, Limit positions, Mechanical advantage,Transmission angle. **Description of some Common Linkages:** Exact and approximate straight-line mechanisms, Steering gear mechanisms, Geneva wheel mechanism, Ratchet and pawl mechanism, Toggle mechanism, Pantograph and Universal joint.	**12**
Unit-2	**Velocity and Acceleration Analysis of Mechanisms:** Displacement, velocity and acceleration analysis of mechanisms having higher and lower pairs by graphical and analytical methods, Instantaneous centre of velocity, Kennedy's theorem, Angular velocity ratio theorem, Kinematic analysis by algebraic methods, Vector approach, Klein's construction, Coriolis acceleration.	**11**
Unit-3	**Kinematic Synthesis of Planar Mechanisms:** Type synthesis, Number synthesis, Dimensional synthesis, Synthesis of mechanism for three accuracy points using graphical and analytical techniques, Freudenstein's equation, Function generation, Path generation, Rigid body guidance. Mechanism defects, Practical consideration in mechanism synthesis. **Cams:** Classification of cams and followers and terminology for cam- follower. Standard follower motions: Uniform velocity, Uniform acceleration and retardation, SHM and Cycloidal motion, their comparison, graphical synthesis of cam profile for a given follower and it's motion, 3-4-5 polynomial cams.	**12**

Unit-4	**Spur Gears:** Introduction, Classification of gears, Gear terminology, Law of gearing, Velocity of sliding, Forms of teeth, Cycloidal profile teeth, Involute profile teeth, Path of contact, Arc of the contact, Numbers of pairs of teeth in contact, Interference in involutes gears, Minimum number of teeth to avoid interference, Interference between rack and pinion, Under cutting, Method of avoiding interference, Comparison of cycloidal and involute tooth forms. **Gear Trains:** Analysis of simple, compound and epicyclic gear trains.	**10**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Text Books** 1. S. S. Rattan, Theory of Machines, 5th Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2019. ISBN-13: 978- 9353166281 2. A. G. Ambekar, Mechanism and Machine Theory, 14th Edition, PHI Learning Pvt. Ltd., New Delhi, 2009, ISBN-13: 978-8120331341 3. J. S. Rao and R. V. Dukkipati, Mechanism and Machine 4. Theory, 1st Edition, Wiley Eastern Limited, 1989. ISBN-13: 978-0470211311 **Reference Books** 1. John J. Uicker Jr., Gordon R. Pennock, Joseph E. Shigley, Theory of Machines and Mechanisms, 6th Edition, Cambridge University Press, New York, 2023, ISBN-13:978-1009303675 2. Hamilton H. Mabie, Charles F. Reinholtz, Mechanisms and Dynamics of Machinery, 4th Edition, John Wiley & Sons, New York, 1987, ISBN-13: 978-0471802372 3. Ghosh A., Mallik A.K., Theory of Mechanisms and Machines, 3rd Edition, Affiliated East-West Press, New Delhi, 1998. ISBN-13: 978-8185938936	
Course Outcomes:	CO 1. Remember the basic principles, kinematic concepts, inversions of mechanism, cams and gears. CO 2. Understand the kinematics of rigid bodies, planar mechanism, Kinematic synthesis and motion of cam and gears. CO 3. Apply & calculate velocity and acceleration of machines, cams and gears. CO 4. Analyse the velocity and acceleration for mechanisms having higher and lower pairs, cams and gears.	

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-206**
Title of the Course : **Kinematics of Machines Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Prerequisites for the Course:	Knowledge of Applied Physics, Applied Mechanics	
Course Objectives	1. To provide an insight in to velocity and acceleration analysis of simple and compound mechanism. 2. To carry out design of cam and follower for various standard follower programs, 3. synthesize a mechanism to satisfy a given function and carry out rigid body guidance.	
Content:	**LIST OF SHEETS**	**No. of Hours**
	1. Two sheets on velocity and acceleration diagram for simple and compound mechanism. 2. Two sheets on velocity and acceleration diagram for mechanism involving Coriolis slider. 3. One sheet on I-center method for simple and compound mechanism. 4. One sheet on Synthesis of four bar mechanism and rigid body guidance 5. Two sheets on displacement diagram for follower and cam profile.	**30**
Pedagogy:	Inquiry based Learning, Constructive and Collaborative Learning.	
Course Outcomes	CO 1. Understand the basic principles, kinematic concepts of simple and compound mechanism, cams. CO 2. Describe displacement, velocity and acceleration of simple and compound mechanism, cams**.** CO 3. Apply the knowledge to plot velocity and acceleration diagrams for simple and compound mechanism, displacement diagram for follower and cam profile using graphical methods. CO 4. Analyse displacement, velocity and acceleration for mechanisms and cams.	

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-207
Title of the Course : Internal Combustion Engines
Number of Credits : 2
Effective from AY : 2024-25

Prerequisites for the Course:	Applied Thermodynamics, Fundamentals of Mechanical Engineering.	
Course Objectives:	The main objective of studying internal combustion engines is to 1. Understand how these engines convert chemical energy into mechanical power. 2. Analyze their performance, efficiency, and impact on the environment. 3. This knowledge is crucial for designing, developing, and improving ICEs for various applications, including transportation and power generation.	
Content		**No of hours**
Unit - 1	**Engine Construction and Operation:** Heat engines; Internal and external combustion engines; Classification of I.C. Engines; Cycle of operations in four strokes and two-stroke IC engines and their comparative study. **Fuels**: Important qualities of the Engine fuels - (SI & CI engines), Rating of Fuels, Alternate fuels for SI & CI engines,	**8**
Unit - 2	**Combustion in IC Engines:** Combustion in spark Ignition engines, stages of combustion, flame propagation, rate of pressure rise, abnormal combustion, Phenomenon of Detonation in SI engines, effect of engine variables on Detonation, Combustion in compression ignition engines, stages of combustion, factors affecting combustion, Phenomenon of knocking in CI engine, Comparison of knocking in SI & CI engines.	**8**
Unit - 3	**Engine Testing and Performance:** Introduction, Frictional Power, Brake Power, Indicated Power, Fuel Consumption, Air Consumption, speed, Emissions, mean effective pressure, Methods to determine power and efficiencies, Variables affecting performance of engine, heat balance sheet.	**7**
Unit - 4	**Emission of I.C. Engines:** Engine emissions, Hydrocarbon emissions, (HC) & PPM & Carbon monoxide emissions (CO), oxides of Nitrogen (NOx), Emission control methods for SI and CI engines, **Modern Trends in I C Engines.:** GDI, MPFI and CRDI, VCR engine, VTEC engine, Rotating Liner Engine, HCCI engine,	**7**
Pedagogy:	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and	

	problem-solving skills.
References/ Readings:	**Text Books** 1. Obert E.F., "Internal combustion Engine and Air Pollution", 3rd Edition, Intext Educational Pub,1973. ISBN-13: 978-0700221837 2. Ganesan V., "Internal combustion Engines", 6th Edition.Tata McGraw Hill Publishing Co. ISBN-13: 978-0074621226 3. Mathur M.C.,Sharma R.D.,"Internal combustion engines",8th Edition.; Dhanpat Rai publication , 2003. ISBN-13: 978-8189928469 **Reference Books** 1. Heywood J.B., "Internal combustion Engine Fundamentals", 1st Edition, McGraw Hill, 1988. ISBN-13: 978-0070286375 2. Pulkrabek W, "Engineering Fundamentals Of Internal Combustion Engine", 1st Edition, Prentice Hall, 1997. ISBN-13: 978-0135708545
Course Outcomes:	CO 1. Understand the construction and operation of engine with alternate fuels used and modern trends in IC Engines. CO 2. Illustrate principle of combustion in Internal Combustion Engines. CO 3. Analyse Performance characteristics of the engine,. CO 4. Evaluate performance and emissions of IC Engines

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-208**
Title of the Course : **Internal Combustion Engines Lab**
Number of Credits : **2**
Effective from AY : **2024-25**

Pre-requisites for the course	Theory of Internal Combustion Engine	
Course Objectives:	1. To study the basic operating principles of SI (Spark Ignition) and CI (Compression Ignition) engines. 2. To familiarize students with engine cycles (Otto, Diesel, Dual) through practical observation and measurement. 3. To understand how different factors affect engine efficiency and output. 4. To understand how different factors affect engine efficiency and output.	
Content:	**List of Experiment**	**No. of Hours**
	1. Performance analysis of Actual Cycle (various losses) and Its comparison with Air standard Cycle 2. Performance analysis on Jet Propulsion Thermodynamics Cycle 3. Performance Test on Diesel Engine. 4. Performance Test on Petrol Engine Engine. 5. Morse Test on Multi cylinder Diesel Engine. 6. Emission Analysis of Petrol Engine/Diesel Engine. 7. Performance test on Diesel Engine to analyse Air Fuel ratio and Volumetric Efficiency. 8. Performing heat Balance test on SI/CI Engine 9. Performing Williams line method (graphical method) to estimate the frictional power 10. Analysis of Supercharging and Turbocharging of IC Engine 11. Comparison of Bharat Stage Six norms with Euro 6 Norms 12. Analysis of MPFI, GDI and CRDI Engines 13. Performance study of carburetion in SI engines and Mechanical Injection Systems of CI Engines. 14. Analysis of BS6 diesel emission control system 15. Analysis of Selective Catalytic Reduction (SCR).	**60**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
Course Outcome:	CO 1. Understand various physical systems of an IC Engines and understand their constructional details, functions. CO 2. Apply various methods to calculate performance of IC Engines CO 3. Analyse performance, emissions and properties of used in IC Engines CO 4. Evaluate the performance and emissions characteristics	

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-209
Title of the Course : Manufacturing Technology - I
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the course	Knowledge of Material Science, Physics and Mathematics	
Course Objectives	1. To introduce basic manufacturing processes -- casting, metal forming, welding, plastic and polymer matrix composites processing. 2. To understand how the different products are manufactured, their process details and process parameters. 3. To impart knowledge on basic manufacturing processes, which will be essential to understand advanced courses being offered in the area of manufacturing. 4. To perform engineering analysis of basic manufacturing processes.	
Content:	**Topics**	**No. of Hours**
Unit-1	Introduction and overview of manufacturing, Recent developments in manufacturing Fundamentals of metal casting, Sand casting process, Production sequence, Sand casting moulds, Casting terms, Heating and pouring, Engineering analysis of pouring; Fluidity, Solidification time, Shrinkage, Directional solidification, Pattern allowances, Pattern material, Types of patterns, Moulding materials, Moulding machines, Cores, Core types, Core prints, Chaplets, Chills, Forces acting on moulding flasks, Typical gating system and its elements, Riser design – Chvorinov's rule and Caine's method Other expendable mould casting processes – shell, vacuum, investment Permanent mould casting processes – low-pressure casting, die casting – hot and cold chamber; centrifugal casting and its types Casting yield, Fettling, Casting quality, Product design considerations in casting	**12**
Unit-2	Fundamentals of metal forming, Classification, Material behaviour in metal forming, Temperature in metal forming -- hot and cold working Rolling, Engineering analysis of flat rolling; Shape rolling, Various configurations of rolling mills, Related rolling processes – thread, ring, gear, roll piercing; Defects in rolling Forging, Engineering analysis of open-die forging; Forging presses, Forging dies, Related forging processes – upsetting, heading, swaging, radial forging, roll forging, trimming; Defects in forging Extrusion, Types, Engineering analysis of extrusion; Impact extrusion, Hydrostatic extrusion, Defects in extruded products Wire and bar drawing, Engineering analysis of drawing; Tube drawing	**11**
Unit-3	Sheet metal working, Cutting operations -- shearing, blanking,	**11**

	punching, Engineering analysis of sheet metal cutting; Bending operations – V and edge, Engineering analysis of bending; Drawing operation, Engineering analysis of drawing; Defects in drawing Shaping processes for plastics, Extrusion, Injection moulding, Compression moulding, Blow moulding, Rotational moulding, Thermoforming, Production of sheet and film – slit-die extrusion, blow-film extrusion, calendering; Product design considerations in shaping of plastics Processing of polymer matrix composites, Classification, Starting materials, Matrix and reinforcement, Shaping processes – hand lay-up, spray-up; Autoclave	
Unit-4	Fundamentals of welding, Types of welding processes, Safety issues, Automation in welding, Types of weld joints, Arc welding – SMAW, GMAW, FCAW, SAW, GTAW; Power source in arc welding, Resistance welding -- spot, seam, projection, flash, upset, percussion; Power source in resistance welding, Oxyfuel gas welding – oxyacetylene, alternative gases for oxyfuel welding; Other fusion welding processes – EBW, LBW, electroslag, thermit; Solid state welding – forge, explosion, friction, friction stir; Weld quality, Weldability, Design considerations in welding, Concepts of brazing and soldering	**11**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/Readings:	**Text Books** 1. Mikell P. Groover; Principles of Modern Manufacturing, Fifth Edition; Wiley Student Edition. ISBN-13: 978-1118474204 2. P. N. Rao; Manufacturing Technology: Foundry, Forming, Welding, Volume- I; Fifth Edition; Tata McGraw-Hill Publishing Company Limited. India ISBN-13: 978-9353160500 **Reference Books** 3. R. K. Rajput; Manufacturing Technology (Manufacturing Processes); Second Edition; Laxmi Publications (P) Ltd.India ISBN-13: 978-8131802441 4. Serope Kalpakjian, Steven R. Schmid; Manufacturing Engineering and Technology; Seventh Edition; Pearson India Education Services Pvt. Ltd. ISBN-13: 978-9332587908	
Course Outcomes:	CO 1. Understand the classification, scope, concepts and applications of basic manufacturing processes used in industries. CO 2. Apply the knowledge, principles and techniques for selection of manufacturing process and manufacturing problem solving. CO 3. Analyze different aspects of manufacturing processes to make inferences. CO 4. Evaluate various criteria, parameters and facts of manufacturing processes to interpret the results of engineering investigations.	

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-210
Title of the Course : Manufacturing Technology - I Lab
Number of Credits : 1
Effective from AY : 2024-25

Pre-requisites for the course	Concepts of manufacturing technology. Knowledge of basic workshop practice.	
Course Objectives	1. Apply basic manufacturing processes to fabricate simple engineering components. 2. Evaluate workshop safety protocols to ensure safe handling of tools, machinery, and hazardous materials. 3. Analyze common defects in welding and casting to propose corrective measures. 4. Evaluate radiographic films to identify welding defects.	
Contents:		**No. of Hours**
	List of Experiments: 1. Demonstration of safety practices, tools used and machines in the workshop. 2. Demonstration of different welding methods, weld and welding symbols, welding positions. 3. Perform a welding job that includes butt/ lap joint of 3G level. 4. Identification of weld defects using the radiographic films or Ultrasonic or penetration testing. 5. Demonstration of properties of moulding sand – permeability, grain fineness and moisture content. 6. Prepare a wooden pattern by applying all suitable allowances. 7. Perform a foundry job (preferably aluminium casting) with a pattern produced in Expt. No. 6. 8. Interpretation of casting defects and finding the root cause(s). 9. Perform a hot forging job of given dimension such as chisel, eye bolt or any other job of equivalent difficulty level. 10. Perform a sheet metal job such as first aid box, oil measuring can or any other job of equivalent difficulty level.	**30**
Pedagogy:	Inquiry based Learning, Constructive and Collaborative Learning.	
Course Outcomes	CO 1. Understand the use of limits, fits, tolerances, GD&T in production drawings. CO 2. To illustrate lathe turning knowledge and SMW to machine the stock to required dimensions and to create simple SMW products.Draw assembly and disassembly of various mechanical systems. CO 3. To demonstrate Grinding machine to make a single point cutting tool and working of Milling, Drilling and Shaper. CO 4. Draw assembly and disassembly of various mechanical systems.	

Professional Electives

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-225
Title of the Course : Numerical Methods & Computer Programming
Number of Credits : 3
Effective from AY : 2025-26

Pre-requisites for the course	A strong foundation in calculus, linear algebra at an undergraduate level, and some basic programming skills in a language like Python /MATLAB/C++	
Course Objectives:	1. To equip students with the understanding and ability to use computational techniques to approximate solutions to complex mathematical problems, 2. Computing roots of nonlinear and transcendental equations using various numerical techniques 3. Solving systems of equations using numerical methods 4. Performing numerical integration and differentiation, and solving differential equations, by utilizing various numerical methods while analyzing potential errors and limitations	
	Content	**No of hours**
Unit - 1	**Errors and Roots of Transcendental and Polynomial Equations:** Errors: Roundoff error, Local truncation error, Global truncation error; Order of a method, Convergence, and terminal conditions; Bisection method, Secant method, Regula−Falsi method, Newton−Raphson method.(Algorithms and computer programming)	**12**
Unit - 2	**Finite Differences and Interpolation:** Forward, backward, central differences, relationship between finite difference operators, Factorial polynomials. **Interpolation with equal Intervals:** Newtons forward and back ward difference formulas, Stirling's and Bessel's central difference Interpolation formulas. (Algorithms and Computer programming) **Interpolation with unequal intervals**: Divided difference, properties , newtons divided difference formula. Lagrange's Interpolation formula. (Algorithms and Problem solving)	**12**
Unit - 3	**Solutions of Linear systems and Eigen value problem:** **Direct Methods:** Gauss elimination and Gaus Jordan Methods(Algorithms and problem solving) **Indirect Methods:** Gauss Seidel d's and Jacobi Methods (Algorithms and problem solving) Power method to compute eigen value ((Algorithm and problem solving)	**09**
Unit - 4	**Numerical Integration and Numerical solutions of differential**	**12**

	equations: Numerical integration using Trapezoidal, Simpson,s 1/3rd and Simpson's 3/8 th rule.((Algorithms and problem solving). Numerical solutions of first order ordinary differential equation using Euler's and Runge Kutta Methods. Predictor Corrector Methods (Euler's and Milne,s Thompson Method.((Algorithm and problem solving)	
Pedagogy:	Classroom Teaching, Inquiry-Based Learning, Reflective, Integrative Learning	
References/ Readings:	**Text Books** 1. T. V. Veerajan, T. Ramachandran, Theory and Problems in Numerical Methods, 1st Edition, Tata McGraw Hill Publication Company Ltd, 2008, ISBN-13: 978-0070534643 2. Quingkai kong, Timmy Siauw, Alxandre Bayen, Python Programming And Numerical Methods: A Guide For Engineers And Scientists, 1st Edition, Academic press, 2020, ISBN-13: 978-0128195499 3. E. Balagurusamy, Numerical Methos, 1st Edition, Tata McGraw Hill Publication Company Ltd, 2018, ISBN-13: 978-0074633113 **Reference Books** 1. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, 7th Edition, Pearson Education, 2003, ISBN,-13: 978-0070534640, 2. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006, ISBN: 9788126531356	
Course Outcomes:	CO 1. Analyze errors in numerical computations, Root finding techniques (Bisection, Newton-Raphson, Secant method, Regula falsi Method.) CO 2. To interpolate using equally spaced and unequally spaced numerical methods. CO 3. To solve linear systems using numerical methods CO 4. To compute integration using numerical methods and also to solve first order ODE using Numerical Techniques.	

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-226
Title of the Course : Numerical Methods & Computer Programming Lab
Number of Credits : 1
Effective from AY : 2024-25

Pre-requisites for the course:	Python /MATLAB/C++/ TK Solver	
Course Objectives:	To be able to model and solve Numerical Method problems using Python/MATLAB/ C++ Programs/ TK Solver	
Contents:		**No of Hours**
	1. Bisection method 2. Secant method and Regula−Falsi method 3. Newton-Raphson method 4. Lagrange's interpolation and Newton's interpolation. 5. Gauss elimination and Gauss Jordan Method 6. Gauss−Jacobi method and Gauss−Seidel method 7. Trapezoidal rule and Simpson's rule 8. Euler's, and Runge-Kutta methods for solving first order initial-value problems of ordinary differential equations. 9. Using least-squares approximation to fit curves to data. 10. Numerical Solution of Laplace equation in two variables bysuitable method	**30**
Pedagogy:	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, and problem-solving approaches	
Course Outcome:	CO 1. **Remember** knowledge of Computer programming to solve numerical method problems using Python/ MATLAB/ C++/TK Solver CO 2. **Understand** knowledge of Computer programming to solve numerical method problems using Python/ MATLAB/ C++/ TK Solver CO 3. **Apply** knowledge of Computer programming to solve numerical method problems using Python/ MATLAB/ C++/ TK Solver CO 4. **Evaluate** problems using Python/ MATLAB/ C++/ TK Solver	

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-227
Title of the Course : Alternate Energy Sources
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the course:	Engineering Thermodynamics	
Course Objectives:	1. At the end of the course, the student is expected to understand and analyse the pattern of renewable energy resources. 2. Suggest methodologies / technologies for its utilization. 3. Economics of the utilization and environmental merits. 4. Understand general physical mechanism of energy conversion.	
Content:		**No. of Hours**
Unit I	**INTRODUCTION:** Indian energy scenario, Need, Characteristics and challenges in the successful utilization of renewable energy sources, Jawaharlal Nehru National Solar Mission. **SOLAR ENERGY:** Solar radiation and its measurements, Solar Angles. Theory of flat plate collectors - Photovoltaic and thermal applications, Limitation of solar energy, Solar water heating, solar drying, solar stills, solar cooling and refrigeration.	**10**
Unit II	**WIND ENERGY:** Basic principle of Wind energy conversion, Wind data and Energy Estimation, Site selection considerations. Types of wind turbines, Terminology, Impact of tower height, Maximum Rotor efficiency (Betz Limit), Wind turbine generators, Average power in wind, Estimation of wind availability, performance evaluation. **GEOTHERMAL ENERGY**: Prospects of geothermal energy in India. Estimation and nature of Geothermal Energy, geothermal sources & resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy.	**12**
Unit III	**OCEAN ENERGY:** Ocean Thermal Energy Conversion (OTEC) System like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitations and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy. **FUEL CELL AND MHD SYSTEMS**: Fuel cell principle, types, Advantages and disadvantages, conversion efficiency, application. MHD Power Generation Principle, Open cycle and Closed cycle, Design problems and developments, Advantages and limitations	**12**
Unit IV	**BIO-ENERGY**: Biomass as a source of energy, Classification of	**11**

	biomass, Biomass conversion process, Types of gasifiers, Briquetting, Gasification and combustion of biomass **ENERGY THROUGH FERMENTATION**: Bio-methanation, biogas as a rural energy source, Environmental significance, Biomass production mechanism, Biogas plant and its components, Types of biogas plants.	
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books** 1. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, 3rd Edition, Tata McGraw-Hill, New Delhi, 2008, ISBN-13: 9780070260641. 2. G. D. Rai, Non-Conventional Energy Sources, 6th Edition, Khanna Publishers, New Delhi, 2005, ISBN-13: 9788174090737 3. M. M. Wakil, Power Plant Technology, 4th Edition, McGraw Hill Book Company, New York, 2011,ISBN-13:9780070702448 4. **Reference Books** 1. J. W. Twidell, A. D Weir, Renewable Energy Resources, 3rd Edition, ELBS Publication, 1986, ISBN: 0415584388 2. D. Hall, R. P. Grover, Biomass Regenerable Energy, 1st Edition, John Wiley and Sons, New York, 1987, ISBN: 0471913482.	
Course Outcomes:	CO 1. Remember basics of commercial and renewable energy sources. CO 2. Understand working principles the various renewable energy sources like wind, solar, biomass, Ocean energy, Fuel cells and MHD systems CO 3. Apply Principles of renewable and new energy source. CO 4. Analyze performance of various alternate Energy Sources	

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-228
Title of the Course : Alternate Energy Sources Lab
Number of Credits : 1
Effective from AY : 2024-25

Pre-requisites for the course:	Engineering Thermodynamics	
Course Objectives:	1. To train the students in Renewable Energy Sources and technologies. 2. To provide adequate inputs on a variety of issues in harnessing Renewable Energy. 3. To recognize current and possible future role of Renewable energy sources.	
Content:	**List of Experiments**	**No of Hours**
	1. Usage and demonstration of various instruments: - Insolation meter, lux meter, pyranometer, pyrheliometer, Anemometer 2. Determination of I-V and P-V Characteristics of solar PV module for different insolation and temperature conditions 3. Series and Parallel connection of solar PV modules to determine the power output and performance characteristics. 4. Determination of MPPT for different configurations of SPV system 5. Site visit of wind power plant/ grid connected 10 kWp solar PV plant/ 6. Simulation of wind energy conversion system 7. Performance assessment of Biomass energy conversion system 8. Study of Bio Gas Power Genration Plant 9. Study, analysis and demonstration of flat plate and concentrating collectors. 10. Experiment on Performance assessment of Micro–Wind Energy Generator.	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
Course Outcome	CO 1. Remember basics of commercial and renewable energy sources. CO 2. Understand working principles the various renewable energy sources like wind, solar, biomass, Ocean energy, Fuel cells and MHD systems CO 3. Apply Principles of renewable and new energy source. CO 4. Analyze performance of various alternate Energy Sources	

Name of the Programme : B.E. Mechanical Engineering
Course Code : MEC-229
Title of the Course : Fundamentals of Turbo Machines
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the course:	Thermodynamics, Fluid Mechanics.	
Course Objectives:	1. Understand the fundamental concepts of turbo machinery. 2. Classify the turbo-machines based on energy interactions. 3. Estimate the performance characteristics of turbo-machines under different operating conditions. 4. Inculcate knowledge in the thermal design of turbo-machines.	
Content:		**No. of Hours**
Unit I	**Introduction:** Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynolds number, Unit and specific quantities. **Thermodynamics of fluid flow:** Application of first and second law of thermodynamics to turbo machines, Efficiencies of turbo machines, Static and Stagnation states, Incompressible fluids and perfect gases, overall isentropic efficiency.	**10**
Unit II	**Energy exchange in Turbo machines:** Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor. **Introduction to reciprocating pumps:** Working principle and construction. Analysis of discharge, work done by the pump, slip, and variations in velocity and acceleration within the suction and delivery pipes. Study of the indicator diagram (theory only)	**12**
Unit III	**Steam Turbines:** Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor. **Hydraulic Turbines:** Classification, various efficiencies. Pelton turbine – velocity triangles, design parameters, Maximum efficiency. Francis turbine - velocity triangles, design parameters, Draft tubes -Types and functions. Kaplan and Propeller turbines – velocity triangles, design parameters.	**12**
Unit IV	**Centrifugal Pumps:** Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel.	**11**

	Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling.	
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books** 1. Kadambi, Manohar Prasad , An Introduction to Energy Conversion, Volume III, 2nd Edition, Turbo machinery V. New Age International Publishers ,2008. ISBN-13: 978-8122431896. 2. B.U.Pai, Turbo Machines, 1st Edition, Wiley India Pvt. Ltd, 2013. ISBN-13:978-8126539550. 3. M. S. Govinde Gowda, A. M. Nagaraj, TurboMachines, 10th Edition,M. M. Publications, 2023. ISBN 13: 978-9362528841 **Reference Books** 1. S. M. Yahya, Turbines, Compressors & Fans, 4th Edition, Tata McGraw Hill Co. Ltd. India 2011, ISBN-13: 978-0070707023. 2. D. G. Shepherd, Principles of Turbo machines, 1st Edition, The Macmillan Company 1964., ISBN-13: 978-0024096609.	
Course Outcomes:	CO 1. Remember the features and understand working of various turbomachines. CO 2. Apply the concepts of energy transformation in turbo machines CO 3. Analyse the energy transfer in Turbo machine with degree of reaction and utilisation factor. CO 4. Evaluate performance of radial power absorbing machine and the problems involved during its operation.	

Name of the Programme : **B.E. Mechanical Engineering**
Course Code : **MEC-230**
Title of the Course : **Fundamentals of Turbo Machines Lab.**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the course:	Thermodynamics, Fluid Mechanics and Theory of Turbomachines	
Course Objectives:	**The course will enable students:** 1. To gain knowledge in performance testing of Hydraulic Turbines and Hydraulic Pumps. 2. To understand cd, cc, cv and Coefficient of impact of various hydraulic systems. 3. To develop the ability to operate, control, and evaluate the performance of turbomachinery setups while adhering to safety guidelines. 4. Acquire practical skills in conducting experiments, collecting data, and interpreting performance parameters of turbomachines.	
Content:	**List of Experiments**	**No of Hours**
	1. Perform and Analyze constant head characteristics of Pelton wheel. 2. Perform and Analyze constant speed characteristics of Pelton wheel Turbine. 3. Perform and Analyze constant head characteristics of Kaplan Turbine 4. Perform and Analyze constant speed characteristics of Kaplan Turbine 5. Performance Test on Compressor 6. Perform and Analyze constant head/speed characteristics of Centrifugal Pump 7. Performance Test on Reciprocating Pump. 8. Performance Test on Gear (Oil) Pump Test Rig 9. Performance Test on Francis Turbine. 10. Performance Test on a Centrifugal fan.	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
Course Outcome	CO 1. Remember to proficiently operate turbomachinery setups, showcasing the ability to safely start, stop, and control machines while adhering to operating guidelines. CO 2. Understand the underlying principles and concepts of various types of turbomachines, comprehending their working mechanisms and basic operational characteristics. CO 3. Analyse the performance testing of Hydraulic Turbines and Hydraulic Pumps at constant speed and head. CO 4. Evaluate the performance testing of Hydraulic Turbines and	

	Hydraulic Pumps at constant speed and head.