Courses of Study

Semester IV

B.Tech Mechanical Engineering

(Batch 2023 Onwards)

Department of Mechanical Engineering

Islamic University of Science and Technology, Kashmir

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Detailed Syllabus for 4th Semester

Total Credits = 19+X *Total Hours Per Week = 24+2[2]*

S.No	Course Code	Course Title	L	T	P	S	Hours Per Week	Credits
1	MEC250C	Applied Thermodynamics	3	0	0	0	3	3
2	MEC254C	Kinematics and Dynamics of Machines	3	0	0	0	3	3
3	MEC255C	Engineering Materials and Applications	3	0	0	0	3	3
4	MEC256C	Fluid Mechanics	3	1	0	0	4	4
5	MEC257C	Industrial Electronics	3	0	0	0	3	3
6	MEC261C	Practicals on Material Characterization	0	0	2	0	2	1
7	MEC262C	Investigations on Fluid Flow	0	0	2	0	2	1
8	MEC263C	Experiments on Energy Systems	0	0	2	0	2	1
9	MEC251A	Internship/Practical Training I[1]	0	0	2	0	2	0
10	MEC252A	Bridge Course on Physics[2]	2	0	0	0	2	0
11		Open Elective						X

Notes:
[1] Contact hours are used for evaluation only. However, the internship or training has to be completed during winter vacations after the 3rd semester. The minimum duration of such internship or training has to be four weeks.
[2] Mandatory for lateral entry students only.

MEC250C Applied Thermodynamics 3-0-0-0

Course Objectives: This course will enable students to:

1. Gain knowledge about the fundamentals of steam and gas power cycles.
2. Acquire knowledge about basics of refrigeration, nozzles, steam turbines and compressors.
3. Learn about the fuels and their heating values.

Course Outcomes: At the end of this course, a student will be able to:

1. Explain various thermodynamic cycles.
2. Describe different methods of refrigeration.
3. Analyse the dynamics of steam flow through nozzles and steam turbines.
4. Estimate the power and efficiency of compressors and explain their characteristics.
5. Perform analysis of combustion process.

Module I

Steam Power Cycles: Carnot cycle, Rankine and modifications in Rankine cycle, work ratio, specific steam consumption, deviation of actual cycles from ideal cycles, cycle efficiency and binary vapor power cycles.

Gas Power Cycles: Carnot, Otto, Diesel and Dual cycles. Thermal efficiency, work output, and mean effective pressure, Comparison of Otto, Diesel and Dual cycles and deviation of actual cycles from ideal cycles. Stirling, Ericsson and Brayton cycle.

Module II

Vapour Compression and Vapour Absorption Cycles: Reversed Carnot cycle, Refrigeration, vapor compression and air refrigeration cycle analysis, vapor absorption cycle, Bell Coleman cycle, gas refrigeration cycles, frost free refrigeration. Refrigerants, Classification of refrigerants.

Module III

Nozzles: Types of nozzles, Critical pressure ratio, isentropic flow through nozzles, Choking, effect of friction, nozzle efficiency, throat and exit areas, supersaturated flow and Stagnation conditions.

Steam Turbines: Types and applications, velocity diagram, work output, blade velocity coefficient, stage, internal and overall efficiency, degree of reaction, losses and efficiency, pressure and velocity compounding and governing.

Module IV

Compressors: Single stage compressor,Reciprocating and Rotary induction diagram and power requirement, effect of clearance volume, volumetric efficiency, multistage compressors, indicator diagram with and without clearance, effect of intercooling, power requirement.

Module V

Fuels and Combustion: Classification of fuels, calorific value and its determination. Combustion equation for Hydrocarbon Fuel, Conversion of Volumetric Analysis to Mass Analysis, Determination of Excess Air Supplied. Determination of Percentage of Carbon in Fuel Burning to CO and CO_2. Determination of Minimum Quantity of Air Supplied to Gaseous Fuels.

Pre-requisites: Engineering Thermodynamics

Text Books:

1. T. D. Eastop, Applied Thermodynamics for Engineering Technologist, Pearson Education, 5^{th} edition, 1993.

2. V. Ganesan, Thermodynamics Basic and Applied, McGraw Hill Education, 1st edition, 2018.

Reference Books:

1. Y. A. Cengel, Thermodynamics: An Engineering Approach, McGraw Hill Education, 8th edition, 2017.
2. Michael J. Moran and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley & Sons, 8th edition, 2014.
3. C. P. Arora, Refrigeration and Air Conditioning, McGraw Hill Education, 3rd edition, 2017.

Online Resources:

1. Applied Thermodynamics by Prof. Niranjan Sahoo, Prof. Pranab K. Mondal (IIT Guwahati), NPTEL Course (https://nptel.ac.in/courses/112103307).
2. Applied Thermodynamics by Dr. Babu Visvanathan (IIT Madras), NPTEL Course (https://archive.nptel.ac.in/courses/112/106/112106314/).

MEC254C Kinematics and Dynamics of Machines 3-0-0-0

Course Objectives: This course will enable students to:
1. Understand the kinematics and rigid- body dynamics of kinematically driven machine components.
2. Understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
3. Understand the kinematics of gear trains.
4. Design linkage mechanism of governor systems to generate specified output motion.

Course Outcomes: At the end of this course, a student will be able to:
1. Select and analyse the kinematic parameters for designing a suitable linkage mechanism.
2. Determine the degrees of freedom of simple mechanisms.
3. Perform the kinematic analysis of simple mechanisms and draw their velocity and acceleration diagrams.
4. Select and design gears for a given input and output motion relationship.
5. Explain the working principle of governors and gyroscopes in motion control.

Module I
Mechanisms: Definition and types of joints; Lower and higher pairs; Classification of mechanisms based on function and constraints; Degree of freedom and Grübler's formula; Grashof's rule and rotatability limits; Mechanical advantage; Transmission angle; Limit positions, slider crank and 4-bar mechanisms and their inversions; Quick return mechanism, Straight line generators, rocker mechanisms, universal joints, steering mechanisms, etc.

Module II
Kinematic Analysis of Simple mechanisms: Displacement, velocity, and acceleration analysis; Velocity analysis using instantaneous centres; Position, velocity and acceleration analysis using loop closure equations; Coincident points; Coriolis component of acceleration.

Module III
Gears and Gear Trains: Gears, classification, law of gearing, involute and cycloidal profiles, path and arc of contact, contact ratio, interference and undercutting, interchangeable gears, helical, bevel and spiral gears, gear trains, classification, simple, compound, reverted, and epicyclic gear trains, analysis of epicyclic gear trains, sun and planet gears, automobile differential.

Module IV
Governors and Gyroscope: Governors, Watt governor, Porter governor, Proell governor, Hartnell governor, controlling force, sensitivity, stability, hunting, isochronism, effort and power of a governor, gyroscope, gyroscopic torque, gyroscopic effects on an aeroplane and ships, gyroscopic stabilisation, stability analysis of a two-wheel vehicle, four-wheel drive on a curved path.

Module V
Flywheel and Cams: Introduction to flywheel, dynamic theory of flywheels, Classification of cams and followers, Terminology for cams, types of follower motions, pressure angle, considerations influencing choice of cam, construction of cam profiles, layout.

Pre-requisites: NA

Text Books:

1. J. J. Uicker, G.R. Pennock, J.E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, 4th Edition, 2014.
2. T. Bevan, Theory of Machines, Pearson Education India, 3rd Edition, 2009.

Reference Books:

1. H. H. Mabie, C.F. Reinholtz, Mechanism and Dynamics of Machinery, Wiley, 4th Edition, 1987.
2. S. S. Rattan, Theory of Machines, McGraw Hill Education, 4th Edition, 2017.
3. A. Ambekar, Mechanism and Machine Theory, Prentice Hall India, 1st Edition, 2007.

Online Resources:

1. Kinematics of Mechanisms & Machines by Prof. Anirvan Das Gupta (IIT Kharagpur), NPTEL Course (https:// archive.nptel.ac.in/courses/112105268).

MEC255C Engineering Materials and Applications 3-0-0-0

Course Objectives: This course will enable students to:

1. Develop understanding of different types of engineering materials and their applications.
2. Correlate between the internal structure of materials and their mechanical properties.
3. Various methods to quantify the mechanical integrity of materials and their failure criteria.
4. Interpretation of equilibrium phase diagrams of alloys.
5. Different heat treatment methods to tailor the properties of Fe-C alloys.

Course Outcomes: At the end of this course, a student will be able to:

1. Describe the basic crystal structures (BCC, FCC, and HCP), recognize other crystal structures, and their relationship with the properties
2. Explain defects in solids and processing of engineering materials.
3. Understand the phase diagram.
4. Understand the properties of different types of polymers and composites.
5. Synthesis and processing of semi-conducting materials for engineering applications.

Module I

Engineering Materials: Introduction to Engineering materials, Crystallography, Crystals, space lattice, unit cell-BCC, FCC, HCP structures-effects of crystalline and amorphous structures on mechanical properties. Theoretical density; polymorphism and allotropy. Miller Indices: - Crystal plane and directions. Fundamentals and crystal structure determination by X-ray diffraction, Mechanism of crystallisation: Homogeneous and heterogeneous Effects of grain size, grain shape Hall -Petch theory, simple problems.

Module II

Crystal Defects: Classification of crystal imperfections, types of dislocation- effect of point defects on mechanical properties, role of surface defects on crack initiation. Burgers vector –dislocation, correlation of dislocation density with strength and nano concept. Polishing and etching to determine the microstructure and grain size determination, diffusion in solids, Fick's laws, mechanisms, applications.

Module III

Phase Diagram: Alloys for engineering applications, Classifications of alloys and solid solutions, Hume- Ruthery rule, equilibrium diagram of common types of binary system. Lever rule and Gibb's phase rule. Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties change with phase transformation. Time temperature phase transformation diagram and heat treatment processes and applications. Surface hardening treatments and applications.

Module IV

Polymers, Ceramics and Composites: Polymers – Classification and applications; Polymerization techniques; Ceramics – Oxide ceramics, ceramic insulators, bio-ceramics and Glasses; Composites – Reinforcement, matrix, metal matrix composites, ceramic composites, polymer composites; Other advanced materials – biomaterials, optical materials, high temperature materials, energy materials, and nanomaterials.

Module V

Electrical and Magnetic Materials: Conducting and resisting materials – types, properties and applications; Semiconducting materials: properties and applications; Magnetic materials – Soft and hard magnetic materials and applications; Superconductors and dielectric materials – properties and applications; Smart materials; Sensors and actuators; Piezoelectric, magnetostrictive and electrostrictive materials, cryogenic materials.

Pre-requisites: Engineering Chemistry

Text Books:

1. V. Raghavan, Material Science and Engineering: A First Course, PHI, 6th Edition, 2015.
2. W. D. Callister and D. G. Rethwisch, Material Science and Engineering: An Introduction, Wiley, 9th Edition, 2013.

Reference Books:

1. D. R. Askeland and P. P. Fulay, Essentials of Materials Science and Engineering, Cengage Learning, 2nd Edition, 2013.
2. G. E. Dieter, Mechanical Metallurgy, McGraw Hill Education, 3rd Edition, 2017.

Online Resources:

1. Introduction to Material Science & Engineering by Prof. Rajesh Prasad (IIT Delhi), NPTEL Course (https://archive.nptel.ac.in/courses/113/102/113102080/_/).

MEC256C Fluid Mechanics 3-1-0-0

Course Objectives: This course will enable students to:

1. Explain fluid motion using quantifiable parameters such as velocity, acceleration, pressure, shear stress.
2. Understand flow in a boundary layer and outside.
3. Understand the flow in pipes.

Course Outcomes: At the end of this course, a student will be able to:

1. Determine and explain pressure exerted by fluids at rest.
2. Interpret and explain fundamentals of fluid kinematics.
3. Apply mass, momentum, and energy conservation equations to various fluid flows.
4. Determine flow properties for boundary layer and potential flows.
5. Determine velocity, pressure gradient and power for internal flows.

Module I

Introduction: History and importance of fluid mechanics; Fluid as a continuum- concept of Knudsen number; Mechanical response of a fluid element; Thermodynamic properties; Viscosity and other related properties, Fluid Statics: Pressure and pressure gradient; manometry, Pressure force on a fluid element, Equilibrium of a fluid element, Hydrostatic forces on plane and curved surfaces, Buoyancy and stability, Pressure distribution in rigid body motion and in uniform rotation

Module II

Fluid Kinematics: Eulerian & Lagrangian of fluid motion, velocity & acceleration, streamline, path line and streak line, 2D stream function in Cartesian & polar coordinates, translation, vorticity & angular velocity, circulation, flow classification.

Module III

Fluid Dynamics: Dimensional analysis, system & control volume, basic & subsidiary laws, transport theorem, laws of conservation of mass, momentum & energy; integral & differential approaches, Euler's and Bernoulli's equations, Bernoulli's equation applications, Navier-Stokes equations, exact solutions.

Module IV

Boundary Layer Theory: 2D laminar boundary layer flow, Prandtl B.L. equation, B.L. along a flat plate, Blassius solution, laminar to turbulent transition, concept of turbulent boundary layer theory. Potential flow hydrodynamics: stream function, potential function, basic two dimensional flows, superposition of flows.

Module V

Pipe Flow: Laminar & turbulent flows in pipes: boundary layer development in pipes, fully developed flow, friction factor, Moody's diagram, energy losses through pipes, bends & pipe fittings, velocity distributions in pipes; power transmission through pipes.

Pre-requisites: NA

Text Books:

1. F. M. White, Fundamentals of Fluid Mechanics, McGraw Hill Education.
2. Y. Cengel and J. Cimbala, Fluid Mechanics: Theory and Applications, McGraw-Hill Education.
3. Reference Books:
4. B. R. Munson, Fundamental of Fluid Mechanics, John Wiley & Sons.
5. R.W. Fox, A.T. McDonald and P. J. Pritchard, Introduction to Fluid Mechanics, Wiley.

Reference Books: NA

Online Resources:

1. Fluid Mechanics by Prof John Biddle (California State Polytechnic University, Pomona) (https://www.cpp.edu/meonline/fluid-mechanics.shtml?gclid=CjwKCAjwzo2mBhAUEiwAf7wjkjD8bCq158MT7UmAWp2LvrCbRbI8xPcp1RvCJwAVPoCyV3yprrO3BBoCtMUQAvD_BwE).

MEC257C Industrial Electronics 3-0-0-0

Course Objectives: This course covers fundamental concepts including number systems, binary arithmetic, Boolean algebra, combinational and sequential circuit design, programmable logic devices, operational amplifiers, and logic families in industrial electronics. Through practical examples and applications, students will master skills to analyse digital data, design circuits, and assess their efficacy, fostering problem-solving and critical thinking.

Course Outcomes: At the end of the course, a student will be able to:

1. Apply a range of number systems, Boolean algebra principles, and error detection codes to manipulate digital data effectively.
2. Design and analyse combinational circuits, including adders, subtractors, multiplexers, and encoders, to perform logical and arithmetic operations.
3. Implement clocked sequential circuits by utilising sequential logic elements like latches, flip-flops, and counters.
4. Examine operational amplifiers and their applications, including differential amplifiers, Schmitt triggers, and active filters, for signal processing tasks.
5. Differentiate and assess the roles of various logic families, programmable logic controllers, and industrial displays within contemporary electronics systems.

Module I

Introduction to Digital Electronics: Number Systems and Codes: Binary, octal, and hexa- decimal number systems, binary arithmetic, binary code, excess-3 code, Gray code, error detection and correction codes. Introduction to alpha numeric codes. Boolean algebra: Postulates/ Boolean algebra relations (commutative, Associative, Distributive etc.) and theorems, logic functions, minimization of Boolean functions using algebraic, Karnaugh map (2, 3, 4 variable) and Quine – McClausky methods, realisation using logic gates.

Module II

Combinational Circuits: Introduction to basic logic gates, truth tables and simple combinational circuits, realisation of basic combinational functions like Half, Full Adder, Half, Full Subtractor, 4-bit RCA, Encoder/Decoder, Multiplexer, Subtraction using 1's complement, Addition subtraction using 2's complement. Introduction to code converters.

Module III

Sequential Logic Circuits: Cross coupled inverters, stable and metastable states (butterfly diagram) latches and clocked and unclocked latches, Flip-Flops: SR, JK, T, D, Master/Slave FF, triggering of FF, Analysis of clocked sequential circuits, state minimization, state assignment, circuit implementation, Registers: shift registers, inter-conversion of shift registers, Counters. Introduction to programmable logic devices (PLDs) and field-programmable gate arrays (FPGAs).

Module IV

Counters and Amplifiers: Ripple counter, decade counter, Mod N counter, presettable counter, programmable counter, implementation for 3, 4 bits, Application of counters. Finite state machine (FSM) basic concepts. Counter design using FSM. Introduction to Operational Amplifier as differential amplifiers, Op-Amp as ZCD, Inverting/non-inverting amplifier, Op-Amp as Schmitt trigger (and its application as smoke detection circuit), Active filters using Op-Amps, Digital to Analog Converter using Op-Amp.

Module V

Logic Families and Industrial Electronics: RTL, DCTL, I^2L, DTL, HTL, ECL, NMOS and CMOS logic gates, circuit diagram and analysis, characteristics and specifications, TTL families and their ICs. Introduction to Programmable Logic Controllers (PLC), HMIs, PLC Fundamentals - (Block diagram of PLC's) PLC components (Power supply, CPU, I/Os List, Communication bus Various ranges available in PLC's). Introduction to 7-segment and dot-matrix displays Need for decoders in 7-segment display. BCD decoder/7-segment driver circuit/IC.

Pre-requisites: Basic Electrical Engineering, Basic Electronics Devices

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Text Books:

1. Morris Mano, "Digital logic and Computer Design ", Prentice-Hall of India. Reference
2. Op-amps and linear integrated circuit technology, by Ramakant A. Gayakwad, Pearson.

Reference Books:

1. Ronald J. Tocci, "Digital Systems, Principles and Applications", Prentice-Hall of India.
2. Dr. B.R Gupta, V. Singhal, " Digital Electronics ", Katson Books

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Online Resources:

1. Digital Electronic Circuits, Prof. Goutam Saha (IIT Kharagpur), NPTEL Course (https://nptel.ac.in/courses/108105132).

MEC261C Practicals on Material Characterization 0-0-2-0

Course Objectives: This course will enable students to:

1. Know the microstructure of different materials.
2. Know the properties of materials at higher elevated temperatures.
3. Refine grain size by heat treatment properties.

Course Outcomes: At the end of this course, a student will be able to:

1. Summarise the crystal structure for SC, BCC, FCC and HCP.
2. Outline the microstructure for pure metals and alloys.
3. Observe the microstructure of heat treated steels.
4. Describe how and why defects (point, line and interfacial) in materials greatly affect engineering properties and limit their use in service.
5. Observe the hardness of alloys, metals by using a quenching test.

List of Practicals

1. To study metallurgical lab practice.
2. To study the crystal models for simple cubic, body centred cubic, face centred cubic and hexagonal close packed structures.
3. To study the micro structures of pure metals like Iron, Al, Cu, Brass specimens under metallurgical microscope.
4. To find out the grain size in single and multi-phase alloy systems.
5. To find the hardness of the various treated and untreated steels.
6. Basics of Scanning Electron Microscopy: Secondary Electron and BSE imaging mode.
7. Feature Size measurement: Porosity, Grain, and Reinforcement.
8. Elemental mapping: Spot, Line and Area Analysis.
9. Basic operations of Transmission Electron Microscope (Imaging and Diffraction Pattern).
10. Electron Diffraction for various materials.

Pre-requisites: N/A

Online Resources:

1. Techniques of Material Characterization by Prof. Shibayan Ray (IIT Kharagpur), NPTEL Course (https://onlinecourses.nptel.ac.in/noc22_mm37/preview)
2. Virtual Labs (An MoE Govt. of India Initiative) (https://emb-iitk.vlabs.ac.in/List%20of%20experiments.html)

MEC262C Investigations on Fluid Flow 0-0-2-0

Course Objectives: This course will enable students to understand fundamentals of fluid flow and acquaint them with fluid flow through turbines and pumps. Students will visualise flow around different geometries in a wind tunnel.

Course Outcomes: At the end of this course, a student will be able to:

1. Apply Pascal's law to hydraulic systems
2. Verify principle of conservation of energy for fluid flows
3. Determine pressure drop across the length of a pipe/obstruction metre

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List of Practicals

1. Estimation of viscosity of a fluid.
2. To study the transition from laminar to turbulent flow and to ascertain lower critical Reynolds number.
3. Determination of velocity distribution in a variable area duct using pitot tube.
4. To Study the Flow through a Variable Area Duct and Verify Bernoulli's Energy Equation.
5. To Determine the Coefficient of Discharge for an Obstruction Flow Metre (VenturiMeter/Orifice Meter)
6. To Determine the Friction Coefficient for Pipes of Different Diameters.
7. To Determine the Head Loss in a Pipe Line Due to Sudden Expansion/ Sudden Contraction/ Bend.
8. To Determine the Velocity Distribution for Pipeline Flow with a Pitot Static Probe.
9. Determination of metacentric height.

Pre-requisites: N/A

Text Books:

1. F .M. White, Fundamentals of Fluid Mechanics, McGraw Hill Education.

Online Resources:

1. Virtual Fluid Laboratory (IIT Patna) (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/).
2. Virtual Fluid Mechanics Lab (IIT Kharagpur) (http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpMF/#).

MEC263C Experiments on Energy Systems 0-0-2-0

Course Objectives: This course will enable students to:

1. Learn about different types of boilers and understand their working principles.
2. Understand the performance characteristics of single and multiple stage compressors.
3. Understand the basics of refrigeration and air conditioning and the thermodynamic cycles governing them.

Course Outcomes: At the end of this course, a student will be able to:

1. Determine the dryness fraction of steam and prepare an energy balance sheet for boilers
2. Describe relationships between various performance parameters like volumetric efficiency, pressure ratio, adiabatic efficiency, and isothermal efficiency.
3. Calculate the COP of Vapour Compression Refrigeration System and air-conditioning system.

List of Experiments

1. To determine the dryness fraction of steam
2. To perform an energy balance test on a fire tube/ water tube boiler.
3. To study the performance of a single stage compressor
4. To study the performance of a multi stage reciprocating compressor with intercooler
5. To study the cut section models of various components of vapour compression refrigeration system – compressor, evaporator, expansion devices and condenser.
6. To study the working of a vapour compression refrigeration system and determine its cop.
7. To perform a study of cooling towers..
8. To study the working of and determine the cop of an air-conditioning system
9. Experimental assessment of heat pump performance curves using r134a/r32 at a variety of evaporating and condensing temperatures.

Pre-requisites: NA

Text Books:

1. T. D. Eastop, Applied Thermodynamics for Engineering Technologist, Pearson Education, 5th edition, 1993.
2. V. Ganesan, Thermodynamics Basic and Applied, McGraw Hill Education, 1st edition, 2018.

Online Resources: NA

MEC251A Internship/Practical Training I 0-0-2-0

Course Objectives: The objective of internship/practical training is to make sure that the students receive hands-on, real-world experience in an industrial setting. It would also provide them exposure to industry-specific challenges, and develop essential skills in problem-solving, teamwork, and project management.

Course Outcomes: At the end of the internship/practical training, a student will be able to explain some of the industrial processes, briefly define a specific industrial environment and develop a deeper understanding of mechanical engineering principles and practices. A student will also develop a heightened awareness of the professional demands and expectations within the industry, preparing them for successful careers in the field.

Few guidelines for the internship/practical training:
The department expects students to do such internships or practical training at some established industrial setups. In particular, the students in the second year shall preferably visit an industry/factory/shop floor or in certain cases only may do some training related to CAD, or other simulation software, etc. All such training shall have to be approved by the Head of the Department beforehand. The internships should be focussed with few objectives rather than just a visit to the industry.

Duration:
Minimum four weeks training or internship only, shall qualify for the evaluation later on, and the award of audit complete.

Evaluation Mode and Rubrics:
The internship or the practical training shall be evaluated in the fourth semester and the students would be awarded the audit complete grade based on the internship/practical training report, attendance during the same, presentation before the departmental committee, and the original certificate submission.

MEC252A Bridge Course on Physics 2-0-0-0

Course Objectives: The objective of the course is to enable students to comprehensively understand and proficiently apply the principles of classical mechanics, mechanical properties of solids and fluids, oscillations, electricity and magnetism, and semiconductor electronics, fostering analytical and problem-solving skills in each area.

Course Outcomes: At the end of this course, a student will be able to:

1. Calculate centre of mass motion, analyse translational and rotational motion, and comprehend torque, angular momentum, and moment of inertia principles.
2. Describe simple and damped harmonic motion.
3. Apply Coulomb's law, understand electrostatics and magnetostatics, and analyse electromagnetic field behaviour.
4. Explain semiconductor classifications, analyse semiconductor device operations, and evaluate their applications.

Module I

Classical Mechanics: Centre of Mass, Motion of Centre of mass, Pure Translational and Rotational motion, Torque and angular momentum, Principle of moments (Moment of Inertia), Radius of Gyration, Generalised Motion, Kinematics of rotational motion about a fixed axis. Simple Harmonic Motion, Damped Harmonic motion.

Module II

Electricity and Magnetism: Physical concepts of gradient, divergence, and curl; Laplacian operator, Concept of electricity and magnetism, Coulomb’s law, Electrostatics, Magnetostatics, The Lorentz force, Maxwell's equations, the dynamical magnetic field, the dynamical electric field, Electromagnetic Waves

Module III

Semiconductor Electronics: Classification of metals, conductors and semiconductors, Fermi Level, Intrinsic Semiconductor, Extrinsic Semiconductor, p-n junction, Semiconductor Diode, Half-Wave Rectifier, Full-Wave Rectifier, Zener diode, Photodiode, Light emitting diode, Junction Transistor

Pre-requisites: None

Text Books:

1. Hugh D. Young and Roger A. Freedman, University Physics with Modern Physics, Pearson Education
2. Anderson and Anderson, Fundamentals of Semiconductor Devices, McGraw-Hill Education
3. Reference Books:
4. Stephen T. Thornton and Jerry B. Marion, Classical Dynamics of Particles and Systems, Cengage Learning
5. David J. Griffiths, Introduction to Electrodynamics, Pearson

Online Resources: NA