Semester-III

Subject Code : BS-M(ME)301	**Category:** Basic Science course
Subject Name : **Mathematics III**	**Semester** : Third
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Objectives:

1. To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
2. To provide an overview of probability and statistics to engineers

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variable.	14
2	Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random varibales and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.	12
3	Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	12

Course Outcomes:

Upon completion of this course, students will be able to solve field problems in engineering involving PDEs. They can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Chandrika Prasad & Reena Garg, Advanced Engineering Mathematics, Khanna Publishing House, 2019.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
5. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
6. Ramana, Higher Engineering Mathematics, TMH
7. Sashtry, Advanced Engineering Mathematics, PHI

Subject Code : BS-CH(ME)301	**Category:** Basic Science course
Subject Name : Biology	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction** *Purpose*: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.	2
2	**Classification** *Purpose*: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitataacquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M.musculus	3
3	**Genetics** *Purpose*: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.	4
4	**Biomolecules** *Purpose*: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine	4

Course Outcomes:

	Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	
5	**Enzymes** *Purpose*: To convey that without catalysis life would not have existed on earth. Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	4
6	**Information Transfer** *Purpose*: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure-from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.	4
7	**Macromolecular analysis** *Purpose*: How to analyse biological processes at the reductionist level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	5
8	**Metabolism** *Purpose*: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	4
9	**Microbiology** Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3

After studying the course, the student will be able to:

1. Describe how biological observations of 18th Century that lead to major discoveries.
2. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
3. Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
4. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
5. Classify enzymes and distinguish between different mechanisms of enzyme action.
6. Identify DNA as a genetic material in the molecular basis of information transfer.
7. Analyse biological processes at the reductionistic level

8. Apply thermodynamic principles to biological systems.
9. Identify and classify microorganisms.

Learning Resources:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H.John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers
6. Biology for Engineers, Tata McGraw Hill (ISBN: 978-11-21439-931)

Subject Code : ES-ECE(ME)301	**Category:** Engineering Science Courses
Subject Name : Basic Electronics Engineering	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Objective:

To provide an overview of electronic device components to Mechanical engineering students.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	**Semiconductor Devices and Applications**: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.	7
2	**Operational amplifier and its applications:** Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator anddifferentiator.	6
3	**Timing Circuits and Oscillators:** RC-timing circuits, IC 555 and its applications as tableand mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-Cphase shift and Wein bridge oscillator.	6
4	**Digital Electronics Fundamentals** :Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/sub tractor, multiplexers, De-multiplexers, flip-flops, shift registers, counters, Block diagram ofmicroprocessor/microcontroller and their applications.	7
5	**Electronic Communication Systems**: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM andFM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.	6

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor devices and their applications.
2. Design an application using Operational amplifier.
3. Understand the working of timing circuits and oscillators.
4. Understand logic gates, flip flop as a building block of digital systems.
5. Learn the basics of Electronic communication system.

Learning Resources:

1. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2. R.P. Jain , "Modern Digital Electronics", Tata McGraw Hill, 3rd Edition, 2007.
3. S.Biswas, Basic Electronics, Khanna Publishing House, 2019
4. Frenzel, "Communication Electronics: Principles and Applications", Tata McGraw Hill, 3rd Edition, 2001
5. Shanti Ram Kal, Basic Electronics, PHI

Subject Code : ES-ME301	**Category:** Engineering Science Courses
Subject Name : Engineering Mechanics	**Semester** : Third
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Objectives:

The objective of this Course is to provide an introductory treatment of *Engineering Mechanics* to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. A working knowledge of statics with emphasis on force equilibrium and free body diagrams provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	**Module 1**:*Introduction to Engineering Mechanics covering,* Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy.	3
2	**Module 2**: *Friction covering,* Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.	4
3	**Module 3**: *Basic Structural Analysis covering,* Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines.	4
4	**Module 4**: *Centroid and Centre of Gravity covering,* Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.	5
5	**Module 5**: *Virtual Work and Energy Method*- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.	5
6	**Module 6**: *Review of particle dynamics*- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law	5

	(rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).	
7	**Module 7:***Introduction to Kinetics of Rigid Bodies covering,* Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.	5
8	**Module 8:***Mechanical Vibrations covering,* Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums.	5
9	**Tutorials** *from the above modules covering*, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack.	12

Course Outcomes:

At the end of this course students will be able to

1. Use scalar and vector analytical techniques for analysing forces in statically determinate structures.
2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Apply basic knowledge of maths and physics to solve real-world problems.
4. 4.Understand measurement error, and propagation of error in processed data.
5. Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).
6. Understand basic dynamics concepts – force, momentum, work and energy.
7. Understand and be able to apply Newton's laws of motion.
8. Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution.
9. Extend all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces).
10. Learn to solve dynamics problems. Appraise given information and determine which concepts apply, and choose an appropriate solution strategy, and
11. Attain an introduction to basic machine parts such as pulleys and mass-spring systems.

Text /Reference Books:

1. M.P. Poonia & D.S. Bedi, Engineering Mechanics, Khanna Publishing House, 2019
2. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
3. R.S. Khurmi, Engineering Mechanics, S.Chand Publications, Delhi

4. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
5. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
6. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
7. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
8. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
9. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
10. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
11. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

Subject Code : ES-ME302	**Category:** Engineering Science Courses
Subject Name : Materials Engineering	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No prerequisite	

Course Objective:

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams
3. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.	6
2	Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.	6
3	Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to nondestructive testing (NDT)	8
4	Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binaryphase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.	6

5	Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening	6
6	Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys	8

Course Outcomes:

1. Student will be able to identify crystal structures for various materials and understand the
2. defects in such structures
3. Understand how to tailor material properties of ferrous and non-ferrous alloys
4. 3.How to quantify mechanical integrity and failure in materials

Learning Resources:

1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, “Material Science and Engineering’, Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.

Subject Code : PC-ME301	**Category:** Professional Core courses
Subject Name : Thermodynamics	**Semester** : Third
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Course Objective:

1. To learn about work and heat interactions, and balance of energy between system and its surroundings
2. To learn about application of I law to various energy conversion devices
3. To evaluate the changes in properties of substances in various processes
4. To understand the difference between high grade and low grade energies and II law limitations on energy conversion.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.	5
2	Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.	5
3	Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.	8
4	First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.	5
5	Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.	5
6	Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in Ts coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for	8

	systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.	
7	Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.	4

Course Outcomes:

1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions
2. Students can evaluate changes in thermodynamic properties of substances
3. The students will be able to evaluate the performance of energy conversion devices
4. The students will be able to differentiate between high grade and low grade energies.

Learning Resources:

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

Subject Code : PC-ME391	**Category:** Professional Core courses
Subject Name :Machine Drawing I	**Semester** : Third
L-T-P : **0-0-3**	**Credit:1.5**
Pre-Requisites:	

Schematic product symbols for standard components in mechanical, electrical and electronic systems, welding symbols and pipe joints; Orthographic projections of machine elements, different sectional views- full, auxiliary sections; Isometric projection of components; Assembly and detailed drawings of a mechanical assembly, such as a plummer block, tool head of a shaping machine, tailstock of a lathe, simple gear box, flange coupling, welded bracket joined by stud bolt on to a structure, welded pipe joints indicating work parts before welding, etc.

Practicing AutoCAD or similar graphics software and making orthographic and isometric projections of different components.

Semester-IV

Subject Code : PC-ME401	**Category:** Professional Core courses
Subject Name : Applied Thermodynamics	**Semester** : Fourth
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Course Objective:

1. To learn about of I law for reacting systems and heating value of fuels
2. To learn about gas and vapor cycles and their first law and second law efficiencies
3. To understand about the properties of dry and wet air and the principles of psychrometry
4. To learn about gas dynamics of air flow and steam through nozzles
5. To learn the about reciprocating compressors with and without intercooling
6. To analyze the performance of steam turbines

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.	8
2	Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles- Air standard Braytoncycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.	12
3	Properties of dry and wet air, use of psychometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	4
4	Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser.	8
5	Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.	5
6	Analysis of steam turbines, velocity and pressure compounding of steam turbines	3

Course Outcomes:

1. After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
3. They will be able to understand phenomena occurring in high speed compressible flows

Learning Resources:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd

Subject Code : PC-ME402	**Category:** Professional Core courses
Subject Name : Fluid Mechanics & Fluid Machines	**Semester** : Fourth
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Course Objective:

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of dimensional analysis
3. To obtain the velocity and pressure variations in various types of simple flows
4. To analyze the flow in water pumps and turbines.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Definition of fluid, Newton's law of viscosity, Units and dimensions- Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.	9
2	Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.	9
3	Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.	6
4	Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle.	8
5	Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.	8

Course Outcomes:

1. Upon completion of this course, students will be able to mathematically analyze simple flow situations
2. They will be able to evaluate the performance of pumps and turbines.

Learning Resources:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Book Publishing Co., 2018
2. Fluid Mechanics and Machinery, R.K.Bansal, Laxmi Publication.
3. Introduction to Fluid Mechanics & Fluid Machines, Som and Biswas, TMH.
4. A Textbook on Fluid Mechanics and Machines, S.Pati, McGrawHill.
5. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010.
6. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House.

Subject Code : PC-ME403	**Category:** Professional Core courses
Subject Name : Strength of Materials	**Semester** : Fourth
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Course Objective:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.	8
2	Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.	8
3	Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems. Buckling of columns, Euler's theory, critical loads for different types of constraints.	10
4	Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.	8
5	Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure	8

Course Outcomes:

1. After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Learning Resources:

1. D.S. Bedi, Strength of Materials, Sixth Edition, Khanna Publishing House, 2019
2. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
3. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
4. R.K. Bansal, Strength of Materials, Laxmi Publications

5. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.
6. Debabrata Nag and Abhijit Chanda, Fundamentals of Strength of Materials, Wiley India.

Subject Code : PC-ME404	**Category:** Professional Core courses
Subject Name : Manufacturing Processes	**Semester** : Fourth
L-T-P : **4-0-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Course Objective:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Conventional Manufacturing processes: Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.	10
2	Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.	10
3	Machining: Single and multi-point machining; Orthogonal machining, cutting tool geometry of SPTT, milling cutter and drill, conversion of rake and clearance angles within ASA and ISO systems, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.	14
5	Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.	8

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products

Learning Resources:

1. Kalpakjian and Schmid, Manufacturing Processes for Engineering Materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Publication.
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing, Wiley Publication.
4. Mehta & Gaira, Manufacturing Process, Viva Books

Subject Code : PC-ME405	**Category:** Professional Core courses
Subject Name : Metrology & Instrumentation	**Semester** : Fourth
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Objectives:

1. To understand the working of linear and angular measuring instruments.
2. To familiarize with the working of optical measuring instruments and fundamentals of limits and limit gauges.
3. To give basic idea about various methods for measurement of screw thread and surface finish parameters.
4. To give an exposure to advanced measuring devices and machine tool metrology.
5. To provide students an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.
6. To provide basic idea about working principle and applications of devices for measurement of force and torque; strain and stress and temperature.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Concept of measurement:-Introduction to Metrology; Need for high precision measurements; Terminologies in Measurement- Precision, accuracy, sensitivity, calibration, resolution. Errors in Measurement, types of errors, Abbe's Principle. Basic standards of length- Line standard, End standards, Wavelength standard; Various Shop floor standards. Linear Measurement – Slip gauges, wringing, grades; Surface plate; Dial indicators; Height gauges and Vernier calliper; screw gauge. Comparators- mechanical, electrical, optical and pneumatic. Angular Measurement – Bevel protractor; Sine Bar, principle and use of sine bar, sine centre; Angle gauges. Sprit level; Angle Dekkor; Clinometers.	8
2	Limits and Limit gauges – Making to suit, selective assembly, systems of limits and fits; Types of fits; Hole basis system and Shaft basis system. Tolerance, allowance and deviation (as per BIS). Limit Gauges – GO and NO GO gauges; types of limit gauges. Gauge design - Taylor's principle of gauging; Gauge tolerance, disposition of gauge tolerance, wear allowance. Optical Measuring Instruments: - Benefits of light waves as standards; Monochromatic light; Principle of Interference. Interference band, optical flat, surface measurement. Interferometers – NPL, Pitter-NPL, auto collimator.	8
3	Screw thread measurement – Screw thread terminology; Measurement of major diameter; root diameter; pitch; effective diameter with two wire method and three wire method. Measurement of flank angle and form by profile projector and microscope. Measurement of surface texture –	8

	roughness and waviness; Analysis of surface traces, peak to valley height, R.M.S. value, Centre Line Average and Ra value, Rt, Rz etc. Methods of measuring surface roughness – Stylus probe, Tomlinson surface meter, Talysurf; surface roughness measurement – assessment length, roughness width cut-off, sampling length and evaluation length.	
4	Introduction to Digital Measurement– significance of Digital measurement; methods; Classification. Stages in generalized measuring system– Sensor-Transducer stage, Signal-Conditioning stage, Readout-Recording stage; Types of input quantities; Active and Passive transducers. Performance characteristic of measuring devices. Drift, Resolution, Threshold, Hysteresis, Static calibration. Dynamic characteristics- different order systems and their response-, Measuring lag, Fidelity, Dynamic error; Transducers– Working, Classification of transducers. Motion and Dimension measurement – LVDT – Principle, applications, advantages and limitations.	8
5	Strain and Stress Measurement- Electrical resistance strain gauge-Principle, operation. Measurement of Force and Torque– Strain-Gauge Load Cells, Hydraulic and Pneumatic load cells– force measurement using piezoelectric quartz crystal. Torque Measurement– Dynamometers– Mechanical, Hydraulic and Electrical. Vibration measurement– Vibrometers and Accelerometers. Temperature Measurement– Use of Thermal Expansion– Liquid-in-glass thermometers, Bimetallic strip thermometer, Pressure thermometers. Thermocouples– Resistance Temperature Detectors (RTD); Thermistors; Pyrometers.	8

Course Outcomes:

Upon successful completion of the course, student will have

1. Understand the working of linear and angular measuring instruments.
2. Know the fundamentals of limits and limit gauges, various methods for measurement of screw thread and surface roughness parameters and the working of optical measuring instruments.
3. Acquire an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.
4. Get basic idea about working principle and applications of devices for measurement of force and torque; strain and stress and temperature.

Text Books:

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

Subject Code: PC-ME491	**Category:** Professional Core Courses
Subject Name: Machine Drawing II	**Semester**: Forth
L-T-P: **0-0-3**	**Credit: 1.5**
Pre-Requisites: Engineering Drawing	

Course Objectives:

Student will get methodically and well thought out presentation that covers fundamental issues common to almost all areas of machine drawing.

1. Students have an ability to apply knowledge of Modeling, science & engineering.
2. Student can modeled this drawing even in CAD/CAM software by applying the basic knowledge of machine drawing.
3. Students will able to demonstrate an ability to design and conduct experiments, analyze and interpret data and assembly and disassembly drawings knowledge will be provided.

The contents should include about 10 assignments with the focus given as outlined below:

UNIT - I Projection and Isometric Drawing of Machine components

Fasteners: Drawings of various views of Screw threads, metric and BSW threads, Square thread and multi start threads. Nut bolts, Washers, Setscrew, Locknuts and foundation bolts. Riveted joints: Forms and proportions of river heads, Different views of different types of riveted Lap and Butt joints.

Drawings of various views of Shaft joints: Cotter joint and Knuckle joint. Keys & Shaft coupling: Muff, Flanged, Flexible, Universal and Oldhams coupling.

UNIT - II Assignments using graphic software

Assembly and detailed drawings: Tool head of a shaping machine; Engine parts: Eccentric, Piston, Cross head and Connecting rod; Valves: Steam stop valve, Anyone of safety, relief and non-return valves; Solid modeling of Plummer block

Course Outcomes:

1. Understand and apply the knowledge of machine drawing as a system of Communication in which ideas are expressed clearly and all information fully conveyed.
2. To understand the design a system, component or process to meet desired needs within, realistic constraints such as manufacturability, economic, environmental, safety & sustainability etc., to represent a part drawing and assembly drawings.
3. To identify, formulates, analyzes and solve Engineering Problems in Optimum time.

Learning Resources:

1. N.D.Bhatt, Machine Drawing, 46th Edition, Charotar Publishing House, India, 2011.
2. P.S. Gill, Machine Drawing, 18th Edition, S.K. Kataria & Sons, Delhi, 2013.
3. T. Jones, Machine Drawing, John Heywood Ltd, Manchester, UK, 2012.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Subject Code : PC-ME492	**Category:** Professional Core courses
Subject Name : Practice of Manufacturing Processes and Systems Laboratory	**Semester** : fourth
L-T-P : **0-0-3**	**Credit:1.5**
Pre-Requisites: No prerequisite	

List of Experiments:

It should include about 7 experiments from the following list:

i) Laboratory modules of pneumatics and/or electro-pneumatics
ii) Laboratory modules of hydraulics and/or electro-hydraulics
iii) Study of working of Logic Gates practically
iv) Simulation of designed pneumatics / hydraulics systems
v) Measurement of surface roughness
vi) Measurement of tapered objects using Sine Bar and using balls and rollers, etc.
vii) Measurement of threads using three wire method
viii) Measurement of gears
ix) Measurement of bore diameter using micrometer and gauges
x) Measurement of angles using bevel vernier protractor
xi) Statistical process control system to apply to measured dimension of samples
xii) Practicing different gauges to assess angles, thread, internal and external radius, etc.

It should also include about 7 practicing modules (1 module= 3Hour class a week) covering:

1. Pattern Making: 1 or 2 wooden patterns to make- 2 modules
2. Moulding: 1 module
3. Smithy Shop: 2 module
4. Fitting Shop: 2 modules

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Subject Code : MC-ME481	**Category:** Mandatory courses
Subject Name : Environmental Science	**Semester** : Fourth
L-T-P : **0-0-2**	**Credit: 0**
Pre-Requisites: No-prerequisite	

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethoses. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two types of activities.

(a) Awareness Activities:

I. Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
II. Slogan making event
III. Poster making event
IV. Cycle rally
V. Lectures from experts

(b) Actual Activities:

I. Plantation
II. Gifting a tree to see its full growth
III. Cleanliness drive
IV. Drive for segregation of waste
V. To live some big environmentalist for a week or so to understand his work
VI. To work in kitchen garden for mess
VII. To know about the different varieties of plants
VIII. Shutting down the fans and ACs of the campus for an hour or so

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Semester-V

Subject Code : PC-ME501	**Category:** Professional Core Courses
Subject Name : Heat Transfer	**Semester** : Fifth
L-T-P : 3-1-0	**Credit: 4**
Pre-Requisites: Engineering Thermodynamics	

Course Objectives:

1. The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2. Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
3. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.	14
2	Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection-Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow-Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	10
3	Interaction of radiation with materials, definitions of radioactive properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.	9
4	Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε - NTU methods.	7
5	Boiling and Condensation heat transfer, Pool boiling curve.	4
6	Introduction to mass transfer, Similarity between heat and mass transfer.	4

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Course Outcomes:

1. After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer
2. The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer
3. The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Learning Resources:

1. A. Bejan, Heat Transfer, John Wiley, 1993
2. J.P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 6 th Edition, John Wiley, 2007.
4. M. Kaviany, Principles of Heat Transfer, John Wiley, 2002
5. Y.A. Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Subject Code : PC-ME502	**Category:** Professional Core Courses
Subject Name : Solid Mechanics	**Semester** : Fifth
L-T-P : 3-1-0	**Credit: 4**
Pre-Requisites: Engineering Mechanics	

Course Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behaviour of solids.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions	12
2	Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.	10
3	Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.	10
4	Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-D contact problems.	9
5	Solutions using potentials. Energy methods. Introduction to plasticity.	7

Course Outcomes:

Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

Learning Resources:

1. G.T. Mase, R.E. Smelser and G.E. Mase, Continuum Mechanics for Engineers, 3rd Edition, CRC Press, 2004.
2. Y.C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3. L.E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall International, 1969.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Subject Code : PC-ME 503	**Category:** Professional Core Courses
Subject Name : Kinematics and Theory of Machines	**Semester** : Fifth
L-T-P : 3-1-0	**Credit: 4**
Pre-Requisites: Engineering Mechanics	

Course Objectives:

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3. To be able to design some linkage mechanisms and cam systems to generate specified output motion
4. To understand the kinematics of gear trains

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains. Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms**.**	6
2	Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Corioli's component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation**.**	7
3	Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.	5
4	Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion	6

	gears, epicyclic and regular gear train kinematics**.**	
5	Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication, Friction clutches- Belt and Rope drives- Friction in brakes.	6
6	Vibrations– Free and forced vibration of undamped and damped Single DOF systems, Resonance, Transmissibility Ratio, Effect of damping, Vibration Isolation, Critical Speed of Shafts.	6
7	Balancing of Reciprocating and Rotating Masses- Static balancing, Unbalance of force or moment, Dynamic balancing of rotating masses- graphical and analytical methods; Swaying couple; Hammer blow.	4
8	Governors- Use and classification; Study and analysis of Porter, Proell and Wilson-Hartnell governors; Sensitiveness, stability, isochronism, hunting, effort and power of governors.	3
9	Flywheel- Inertia force and inertia torque in reciprocating engine, correction couple (torque), Turning moment diagram and flywheel design.	3
10	Gyroscope- Gyroscopic couple and precessional motion, Effect of gyroscopic couple on aeroplane and ship, Stability of two wheel and four wheel vehicles taking turn.	2

Course Outcomes:
After completing this course, the students can design various types of linkage mechanisms for obtaining specific motion and analyze them for optimal functioning

Learning Resources:

1. T. Bevan, Theory of Machines, 3rd Edition, CBS Publishers & Distributors, 2005.
2. A. Shariff, Theory of Machines, Dhanpat Rai Publication, New Delhi, 2000.
3. W.L. Cleghorn, Mechanisms of Machines, Oxford University Press, 2005.
4. R.L. Norton, Kinematics and Dynamics of Machinery, 1st Edition, McGraw Hill India, 2010.
5. A. Ghosh and A.K. Mallick, Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd., New Delhi, 1988.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Subject Code : HM-HU501	**Category:** Humanities and Social Sciences
Subject Name : Humanities I (Effective Technical Communication)	**Semester** : Fifth
L-T-P : 3-0-0	**Credit: 3**
Pre-Requisites: Basic English	

Course Objectives:

The course aims to teach students the principles of technical communication for their academic and professional needs, focusing on essential written and oral skills for presenting technical information effectively.

Course Contents:

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

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING
(Effective from academic session 2021-22)

Course Outcomes:
After completing this course, the students will be able to
1. Understand the dynamics of Verbal and Non Verbal aspects of technical communication
2. Practice multi-step writing process to plan, draft, and revise reports, correspondence, and presentations.
3. Illustrate and examine the knowledge of ethical aspects of engineering
4. Demonstrate and explain social and professional etiquettes
5. Plan self-development and practice self-assessment to function on multi-disciplinary teams.

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

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Subject Code : MC-ME501	**Category:** Mandatory Courses
Subject Name : Essence of Indian Knowledge Tradition	**Semester** : Fifth
L-T-P : 2-0-0	**Credit: 0**
Pre-Requisites: Nil	

Course Objectives:

To facilitate students with the concepts of Indian traditional knowledge and to make them understand the importance of the root of knowledge system.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge	5
2	Protection of traditional knowledge (TK): the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.	4
3	Legal frame work and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.	5
4	Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.	5

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

Course Outcomes:

After completion of the course, students will be able to:

1. Understand the concept of Traditional knowledge and its importance
2. Know the need and importance of protecting traditional knowledge.
3. Know the various enactments related to the protection of traditional knowledge.
4. Understand the concepts of Intellectual property to protect the traditional knowledge.

Learning Resources:

1. A. Jha, Traditional Knowledge System in India, 2009.
2. B.K. Mohanta and V.K. Singh, Traditional Knowledge System and Technology in India, Pratibha Prakashan, 2012.
3. K. Kapoor and M. Danino, Knowledge Traditions and Practices of India, Central Board of Secondary Education, 2012.
4. E-Resources: http://nptel.ac.in/courses/121106003/

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Subject Code : PC-ME591	**Category:** Professional Core Courses
Subject Name : Mechanical Engineering Laboratory-I (Thermal)	**Semester** : Fifth
L-T-P : 0-0-3	**Credit: 1.5**
Pre-Requisites: Engineering Thermodynamics and Fluid Mechanics and Fluid Machines	

Course Objectives:

To understand the principles and performance characteristics of flow and thermal devices
To know about the measurement of the fluid properties

Course Contents (12 experiments/ studies/ problems are to perform from the list given below or relevant others):

1. Measurement of coefficient of discharge of given Orifice and Venturi meters
2. Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe
3. Determination of the performance characteristics of a centrifugal pump
4. Determination of the performance characteristics of Pelton Wheel
5. Determination of the performance characteristics of a Francis Turbine
6. Determination of the performance characteristics of a Kaplan Turbine
7. Determination of the thermal conductivity and specific heat of given objects
8. Determination of the calorific value of a given fuel and its flash & fire points
9. Determination of the p-V diagram and the performance of a 4-stroke diesel engine
10. Determination of the convective heat transfer coefficient for flow over a heated plate
11. Determination of the emissivity of a given sample
12. Determination of the performance characteristics of a vapour compression system

Course Outcomes:

The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid/thermal machinery

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

SYLLABUS FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

(Effective from academic session 2021-22)

Subject Code : PC-ME592	**Category:** Professional Core courses
Subject Name : Practice of Manufacturing Processes	**Semester** : Fifth
L-T-P : **0-0-3**	**Credit: 1.5**
Pre-Requisites: No prerequisite	

Course Content:

It should include about 12 practicing modules (1 module= 3Hour class a week) covering:

1. Machine Shop: Taper turning, drilling, boring, shaping and milling operations- 6 modules
2. Welding Shop: Practicing SMAW, Welding preparation, Welding defects identification, Gas Welding and/or GMAW -3 modules
3. Sheet Metal Shop: 3 modules

Subject Code : PW-ME581	**Category:** Project (Summer internship)
Subject Name : Project-I	**Semester** : Fifth
L-T-P : **0-0-2**	**Credit: 1**
Pre-Requisites: Nil	

Course Objectives:

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Course Outcomes:

Students will be able to gather some exposure on some projects, may be designing some innovative ideas, fabricating and/or demonstrating an innovative machine or product, etc.