COURSE STRUCTURE(R19)
AND
DETAILED SYLLABUS
(II YEAR)

MECHANICAL ENGINEERING

For
B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2019-20)

LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUK, Kakinada
Accredited by NAAC with "A" Grade and NBA (CSE, EEE & ME)
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B.Tech Course Structure –R19
(w.e.f the Academic Year 2019-20)

II YEAR – I SEMESTER							
S. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1	R19BSH-MA2104	Numerical Methods and Multi variable Calculus	BS	3	0	0	3
2	R19MEC-PC2101	Mechanics of Solids	PC	3	0	0	3
3	R19MEC-PC2102	Material Science & Metallurgy	PC	3	0	0	3
4	R19MEC-PC2103	Fluid Mechanics & Hydraulic Machines	PC	3	0	0	3
5	R19MEC-PC2104	Thermodynamics	PC	3	0	0	3
6	R19MEC-PC2105	Machine Drawing	PC	1	0	3	2.5
7	R19MEC-PC2106	Metallurgy & Mechanics of Solids Lab	PC	0	0	3	1.5
8	R19MEC-PC2107	Fluid Mechanics & Hydraulic Machines Lab	PC	0	0	3	1.5
9	R19MEC-MC2102	MOOCS-1	MC	0	0	0	0
10	R19BSH-MC2101	Essence of Indian Traditional Knowledge	MC	1	0	0	0
			Total	**17**	**0**	**09**	**20.5**

II YEAR – II SEMESTER							
S. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1	R19BSH-MA2202	Complex Variables, Probability& Statistics	BS	3	0	0	3
2	R19MEC-PC2201	Kinematics of Machinery	PC	3	0	0	3
3	R19MEC-PC2202	Applied Thermodynamics	PC	3	0	0	3
4	R19MEC-PC2203	Production Technology	PC	3	0	0	3
5	R19MEC-PC2204	Instrumentation & Control Systems	PC	3	0	0	3
6	R19MEC-PC2205	Design of Machine Members	PC	3	0	0	3
7	R19MEC-PC2206	Production Technology Lab	PC	0	0	3	1.5
8	R19MEC-PC2207	Instrumentation & Control Systems Lab	PC	0	0	3	1.5
9	R19BSH-MC2204	English for Competitive Exams	MC	0	0	3	0
10	R19MEC-PJ2201	Socially relevant Project	PJ	0	0	1	0.5
11	R19MEC-MC2201	MOOCS-2	MC	0	0	0	0
12	R19MEC-SI2201	Summer Internship	MC	0	0	0	0
			Total	**18**	**0**	**15**	**21.5**

II Year –I Semester

Subject Code	Subject Name	L	T	P	C
R19BSH- MA1204	Numerical Methods and Multivariable Calculus	3	0	0	3

Course Objectives:

- To familiarize the numerical techniques for solving non-linear equations, interpolation, differentiation, integration and ordinary differential equations.
- To enlighten the learners in the concept of Multivariable Calculus.

Course Outcomes:

At the end of the course, the student will be able to

1. Solve non-linear equations using various numerical methods.(L2)
2. Construct interpolation polynomials for a given data using Lagrange's and Newton's interpolation formulae.(L2)
3. Apply numerical methods to find derivatives, integrations and solutions of ordinary differential equations(L3)
4. Evaluate the surface area of solids using multiple integrals and apply the properties of Beta, Gamma functions to evaluate the integrals. (L3)
5. Estimate the work done against a field, circulation and flux using vector integral theorems. (L3)

Unit I: Solution of Algebraic and Transcendental Equations (10 hours)

Intermediate value theorem (statement only), geometrical representation of a solution of an equation, Bisection method, Regula-Falsi method, Iterative Method, Newton-Raphson method for one variable and two variables.

Learning Outcomes:

At the end of this unit, the student will be able to

- find approximate roots of an equation by using different numerical methods. (L3)

Unit II: Interpolation (8 hours)

Finite differences, symbolic relations between operators, interpolation using Newton's forward, backward formulae, Gauss central difference formulae, Interpolation with unequal intervals using Newton's divided difference and Lagrange's formulae.

Learning Outcomes:

At the end of this unit, the student will be able to

- explain various discrete operators and find the relation among operators. (L2)
- apply forward and backward interpolation formulas for equal intervals to find interpolating polynomial/values. (L3)
- apply Newton's divided difference and Lagrange's formulas for unequal intervals to find interpolating polynomial/values. (L3)

Unit III: Numerical differentiation, Integration and solutions of Ordinary differential equations: (10 hours)

Numerical Differentiation & Integration: Derivatives using forward& backward difference formulae,Trapezoidal rule and Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

Solutions of Ordinary Differential Equations: Taylor's series method, Picard's method of successive approximation, Euler's method, modified Euler's method and Runge-Kutta method of fourth order for solving first order differential equations.

Learning Outcomes:

At the end of this unit, the student will be able to

- find derivatives and integration of a function by using different numerical methods. (L2)
- solve ordinary differential equations by using different numerical schemes. (L3)

Unit IV: Multiple Integrals and Beta, Gamma Functions (10 hours)

Double and Triple Integrals: Double integrals, double integration in polar coordinates, change of variables, change of order of integration, evaluation of triple integrals, change of variables in triple integral (cartesian to cylindrical and spherical polar co-ordinates).

Beta and Gamma functions: Beta and Gamma functions and their properties, relation between Beta and Gamma functions.

Applications: Area enclosed by plane curves, mass, centre of gravity

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate double integral of functions of several variables in two dimensions using cartesian and polar coordinates. (L3)
- evaluate triple integrals in cartesian, cylindrical and spherical geometries. (L3)
- apply double integration techniques in evaluating areas enclosed by plane curves. (L3)
- apply triple integration techniques in evaluating volumes bounded by a region. (L3)
- apply the special functions in engineering problems. (L3)

Unit V: Vector Calculus (10 hours)

Vector Differentiation: Scalar and vector point functions, vector operator del, del applied to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

Application: Equation of continuity, potential surfaces

Vector Integration (All Theorems without proofs)Line integral, circulation, surface integral, volume integral, Green's theorem in the plane, Stoke's theorem, Divergence theorem.

Application: Work done, flux.

At the end of this unit, the student will be able to

- apply operator del to scalar and vector point functions. (L3)
- illustrate the physical interpretation of gradient, divergence and curl. (L3)
- find the work done in moving a particle along the path over a force field. (L2)
- evaluate the rates of fluid flow along and across curves. (L3)
- apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals. (L3)

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44/e, 2017.
2. B.S. Grewal, Numerical Methods in Engineering & Science, Khanna Publishers, 2014.

References:

1. Erwin kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
3. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018.
4. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
5. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
6. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.
7. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2/e, Reprint 2012.
8. Sastry, S.S, Introductory Methods of Numerical Analysis, 5th edition, , Prentice Hall , 2017.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2101	Mechanics of Solids	3	0	0	3

Course Objectives:

- Introduce the concepts of different stresses, strains and their relationships.
- Discuss the principal stresses and components of stress on different planes and maximum shear force and bending moment of different beams under different loading conditions.
- Demonstrate bending stress and shear stress distribution of various cross sections of beams and to predict the maximum slope and deflection of beams.
- Focus on the stresses and deformations of the springs.
- Familiarize the Euler's concept of buckling in columns & struts.

Course Outcomes:

At the end of the course, student will be able to

1. Apply the concepts of stress and strain to machine numbers. (L3)
2. Determine, shear forces, and bending moments in beams. (L4)
3. Demonstrate the shear stress and bending stress distribution in different cross section of beams. (L3)
4. Estimate the stress in machine members such as shafts and springs.(L4)
5. Analyse columns for buckling loads and estimate the stresses in thin cylinders due to internal pressure.(L4)

Unit I: Stresses and Strains

Types of stresses and strains, stress-strain relations, stress-strain diagram for ductile and other materials, axial loaded bars of uniform and varying cross section, compound bars, relation between three elastic moduli, thermal stresses.

Principal stresses and strains: Biaxial state of stress with and without shear - Mohr's Circle and analytical methods.

Application: beams and structures

Learning outcomes:

At the end of the unit, student will be able to

- Determine stresses and deformations due to axial loads in simple members. (L3)
- Analyse stresses compound bars due to temperature raise. (L4)
- Correlate the elastic constants of materials.(L3)
- Construct the Mohr's circle for calculating principal stresses.(L3)
- Analyse principal stresses in biaxial state of loading. (L4)

Unit II: Analysis of Beams

Types of beams and loads, shear force and bending moment diagram for cantilever, simply supported and overhanging beams for different types of loadings, point of contra flexure, relation between shearing force and bending moment.

Application: analysis of structures and Automobile Chassis.

Learning outcomes:

At the end of the unit, student will be able to

- Draw shear force and bending moment diagrams in beams subject to bending loading.(L3)
- Draw bending stresses in beams under different loading. (L3)

Unit III: Bending Stresses

Flexural equation, bending stress distribution and efficiency of various cross sections of beams.

Shear Stresses: Shear stress distribution for different cross sections of beams.

Deflection of Beams

Differential equations of the deflection curve, Macaulay's method and Moment area method for simply supported, cantilever.

Application: analysis of shafts and couplings.

Learning outcomes:

At the end of the unit, student will be able to

- Demonstrate the shear stress and bending moment distribution in different cross sections of beams.(L3)
- Compare the slope and deflection in beam under different loading.(L5)
- Distinguish various approaches for calculating slope and deflection. (L4)
- Explain the difference between strain energy, resilience, elastic strain energy and modulus of toughness. (L2)
- Evaluate the maximum shear force and bending moment and their location in beams. (L5)

Unit IV: Torsion of Circular Shafts

Theory of pure torsion, transmission of power in solid and hollow circular shafts, comparison of strengths of solid and hollow shafts, shafts in series and parallel, combined bending and torsion.

Springs: Deflection of closed and open coil helical springs under axial force and axial couple.

Application: Power Transmissions Systems and Damping units.

Learning outcomes:

At the end of the unit, student will be able to

- Analyse circular shafts subjected to twisting couple. (L4)
- Determine stresses in shafts subjected to combined loads.(L5)
- Determine angle of twist in shafts.(L5)
- Determine stresses and deformations in helical and leaf springs.(L5)

Unit V: Buckling of Columns

Analysis of columns to evaluate buckling loads with different boundary conditions, Euler's formula and its limitations, Rankine's formula, columns under eccentric load, columns under initial curvature.

Thin Cylinders: Hoop and longitudinal stresses, cylindrical and spherical shells subjected to internal pressure calculation of volumetric strain.

Application: Supporting members and pressure vessels.

Learning outcomes:

At the end of the unit, student will be able to

- Determine buckling load in compressive members. (L2)
- Apply concepts of elastic stability of columns. (L3)
- Assess hoop and longitudinal stresses in thin cylinders. (L3)
- Calculate volumetric strain. (L3)

Text Books:

1. F.P. Beer, E.R. Johnston, Jr&John.T. DeWolf, Mechanics of Materials, 7/e, Tata McGraw-Hill, 2016.
2. SS Rattan, Strength of materials, 3/e, Tata McGraw-Hill, 2016.

References:

1. Timoshenko, Strength of Materials Part-I& II, 3/e, CBS Publishers, 2004.
2. Popov, Mechanics of Solids, 2/e, New Pearson Education, 2015.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2102	Material Science & Metallurgy	3	0	0	3

Course Objectives

- To teach the principles of physical metallurgy, i.e. crystallography of metals, constitution of alloys, phase diagrams and heat treatment of steels.
- Explain the methods to change the properties of materials through heat treatment processes.
- Demonstrate various types of cast irons their properties and applications
- Expose commercially important metals and alloys (both ferrous and non ferrous) with engineering constraints.
- Familiarize properties and applications of ceramics, polymers and composite materials..

Course Outcomes:

After completing the course, the student will be able to

1. Explain the principles of binary phases. (L2)
2. Apply heat treatment to different applications. (L3)
3. Select steel and cast irons for a given application. (L3)
4. Utilize nonferrous metals and alloys in engineering. (L3)
5. Choose composites for various applications. (L3)

Unit I

Structure of Metals: Crystal Structures: Unit cells, Metallic crystal structures, Imperfection in solids: Point, Line, interstitial and volume defects; dislocation strengthening mechanisms and slip systems.

Application: Selection materials for different applications like aerospace, agriculture etc.

Learning Outcomes:

At the end of this unit, the student will be able to

- explain the importance of material science in engineering.(L2)
- Recall the definitions and terminology of crystallography. (L1)

Unit II

Constitution of Alloys: Necessity of Alloying, substitutional and interstitial solid solutions-Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-Iron-carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite, and cast iron.

Application:

1. Phase Diagrams Can Be Used In Solidification And Casting Problems
2. Design and control of heat treatment procedures for specific alloys

Learning Outcomes:

At the end of this unit the student will be able to

- Distinguish metals and alloys. (L4)
- Make use of the principles of construction of binary phase diagrams. (L3)
- Identify various invariant reactions in binary phase diagrams. (L3)
- Explain the concept of Metallography in studying the microstructures of metals and alloys. (L2)

Unit III

Heat Treatment of Steels: Annealing, tempering, normalizing and spheroidizing, isothermal transformation diagrams for Fe-Fe_3C alloys and microstructure development. Continious cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, and vacuum and plasma hardening

Application:

1. Heat treatment of steels can be for changing the physical and mechanical properties like shear strength, toughness and tensile strength of the steel.

2. Heat treated steels can be used in making cutting tools where highly defined edges

Learning Outcomes:

At the end of this unit the student will be able to

- Understand the importance of steel and iron - iron carbide phase diagram. (L2)
- Explain the influence of heat treatment in modification of properties of steels. (L2)
- Develop a heat treatment cycle based on properties required. (L3)
- Explain the principles of surface hardening methods. (L2)

Unit IV

Steels:

Plain carbon steels, use and limitations of plain carbon steels. AISI& BIS classification of steels. Classification of alloys steels. Micro structure, properties and applications of alloy steels-stainless steels and tool steels.

Cast irons:

Micro structure, properties and applications of white cast iron, malleable cast iron, grey cast iron, nodular cast iron and alloy cast irons.

Application:

1. Plain carbon steels Used for cold headed fasteners and bolts
2. Plain carbon steel also used for making piston rings and hot rolling of steels etc.

Learning Outcomes:

At the end of this unit the student will be able to

- Classify various types of steels, their properties and applications. (L2)
- Identify various types of cast irons, their properties and applications. (L3)
- Compare steels and cast irons and their limitations in applications. (L3)

Unit V

Non-ferrous Metals and Alloys: Micro structure, properties and applications of copper and its alloys, aluminium and its alloys. Study of Al-Cu phase diagram, precipitation hardening. Micro structure, properties and applications of titanium and its alloys.

Introduction to Ceramics, Polymers and Composites: Classification, properties and applications of ceramics, introduction to polymers and composites. Introduction to super alloys and Nano-materials.

Applications:

1. Applications of Cu are like making Tubes and pipes, Electrical works, Telecommunications, marine etc.
2. Ceramics are used for making IC engine valve components.

Learning Outcomes:

At the end of this unit the student will be able to

- Explain the importance of non-ferrous metals and alloys in engineering applications. (L2)
- Demonstrate various properties and applications of non-ferrous alloys. (L4)
- Differentiate between hardening of ferrous and non-ferrous alloys. (L4)
- Explain the properties of ceramics and their applications. (L2)

Textbooks(s):

1. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
2. R.Balasubramaniam, Callister's Material Science and Engineering, 2/e, Wiley India, 2014.

References:

1. Y. Lakhtin, Engineering Physical Metallurgy, University Press of the Pacific, 2000.
2. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
3. L.H.Van Vlack, Elements of Material Science and Engineering, 6/e, Pearson Education, 2008.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2103	Fluid Mechanics & Hydraulic Machines	3	0	0	3

Course Objectives

- Impart the knowledge of fluid properties and their behaviour in static and dynamic states.
- Apply laws of conservation of mass, momentum and energy to fluid flow problems.
- Explain the importance of impulse momentum equation to calculate impact of jet on different types of vanes.
- Analyse the various components of turbines and study their characteristics curves and power output from turbines. Introduce the concepts of boundary layer
- Learn various problems related to pumps and study their performance characteristics

Course Outcomes

At the end of the course, student will be able to

1 Define fluid properties and their behaviour in static and dynamic states.(L1)
2 Analyse the type of fluid flow patterns and use Continuity equitation to one dimensional fluid flow situations.(L4)
3 Analyse the impact of jet on the vanes.(L2)
4 Analyse the various components of turbines and study their characteristics curves and power output from turbines. Introduce the concepts of boundary layer(L4)
5 Evaluate performance of hydraulic machines (L3)

Unit I

Definition of fluid-continuum, velocity field, stress field, Newton's law of viscosity, Properties - compressibility, surface tension, vapour pressure, manometry

Fluid Kinematics: Methods of Analysis- System and control volume, differential and integral, Kinematics-stream tube, stream function, potential function, vortex motion, free and forced vortices, continuity equation, Classification of flows-steady and unsteady, uniform and nonuniform, laminar and turbulent, rotational and irrotational, viscous and inviscid, internal and external flows.

Applications: Blood circulation in human body is laminar flow.

Learning outcomes:

After completion of this unit, students will be able to

- Interpret the properties of fluid and their application (L2)
- Select appropriate method for analyzing fluid flow problems (L1)
- Understand principles of continuity in fluid motions (L2)

Unit II

Fluid Dynamics: Momentum equation and Bernoulli's equation, Measurement of flow – Venturimeter , orificemeter and pitot tube, stagnation properties, Exact flow solution-Couette and Poisuielle flow, concept of boundary layer, measures of controlling boundary layer thickness, Turbulence - Reynolds stresses ,Darcy Weisbach equation - friction factor, minor losses, Moody's diagram

Dimensional analysis : Fundamental and derived dimensions, Rayleigh method, Buckingham theorem, dimensionless groups, application of dimensional groups, model testing and similitude, types of similarity - geometric, kinematic and dynamic, model testing methods.

Applications:

1. Measuring of fuel in petrol station, In steam power plants to calculate major & minor losses
2. By using dimensional analysis calculation of Reynolds number of fluid flow (To derive dimensionless numbers from derived quantities.)

Learning outcomes:
After completion of this unit, students will be able to
- Convert conservation laws into flow governing equations (L3)
- Apply Bernoulli's principle for determining flow in measuring devices (L3)
- Solve governing equations for solutions of simple fluid flow problems (L3)
- Identify importance of boundary layer and advantages of control (L3)
- Judge factors influencing laminar and turbulent flow (L4)
- Compute major and minor losses in pipe flows (L3)
- Solve for forces exerted by the fluid through impulse momentum equation (L3)

Unit III
Impact of Jets: Impulse momentum equation , Hydrodynamic force of jet striking stationary and moving vanes, flat and curved vanes, centrally and tangentially, series of vanes, radial vanes, velocity triangles, work done and efficiency.
Turbo machinery: hydrodynamic force of jets on stationary and moving flat plate-inclined and curved vanes-jet striking centrally and at tip-velocity diagrams-workdone-efficiency-flow over radial vanes
Applications: Hydraulic Turbines, Blowers and aerospace industry
Learning outcomes:
After completion of this unit, students will be able to
- Estimate forces exerted by jet on blades (L4)
- Classify turbines based on principle of operation (L2)
- Estimate hydrodynamic forces exerted by jet on blades (L4)

Unit IV
Hydraulic Turbines: Classification of hydraulic turbines- Impulse and Reaction turbines, Pelton , Francis and Kaplan turbines, working principles, Unit and specific quantities, performance curves-problems
Applications: Hydraulic power plants
Learning outcomes:
After completion of this unit, students will be able to
- Classify turbines based on principle of operation (L2)
- Calculate various efficiencies of turbines (L2)
- Select suitable turbine for operating conditions (L3)

Unit V
Rotodynamic Pumps: Classification – mixed, axial, construction, principle and application. Centrifugal Pumps: working principle, work done by impeller,priming of pump, performance curves- Cavitation
Positive displacement Pumps: Working - gear pump, vane pump, rotary piston pump, Reciprocating pump - Working, Slip, Indicator diagrams, Air vessels
Applications: These pumps are used for pressure boosting and feeding water to boilers in power plant
Learning outcomes:
After completion of this unit, students will be able to

- Explain construction and operation of different pumps (L2)
- Classify pumps based on principle of operation (L2)
- Calculate efficiencies of pumps (L3)
- Identify pump suitable for an application (L3)

Text Book(s):

1) P N Modi and S M Seth, Hydraulics & Fluid Mechanics including Hydraulics Machines, Standard Book House, 2017
2) S K Som, Gautam Biswas, S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, 2017

References:

1. C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Fluid Mechanics and Machinery, Oxford University Press, 2010
2. Yunus Cengel, John Cimbala, Fluid Mechanics, McGraw Hill Education, 2017
3. Jagdish Lal, Hydraulic Machines Including Fluidics, Metropolitan Book Co. Pvt. Ltd., 2016

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2104	Thermodynamics	3	0	0	3

Course Objectives

- Familiarize concepts of heat, work, energy and governing rules for conversion of one form to other.
- Relate different properties of matter using laws of thermodynamics.
- Analyze the properties of steam undergoing various thermodynamic processes using tables & Charts
- Introduce the fundamental concepts and applications of thermodynamics cycles
- Impart the knowledge on mixture of perfect gasses and their properties using different laws and charts.

Course Outcomes

1. Identify concepts of heat, work, energy and governing rules for conversion of one form to other.(L1)
2. Explain relationships between properties of matter and basic laws of thermodynamics. (L2)
3. Explain the concept of available energy for maximum work conversion(L1)
4. Analyse the steam properties to understand working of steam power plants.(L4)
5. To enable the students to Provide fundamental concepts of thermodynamics cycles used in steam power plants, IC engines and gas turbines(L2)

Unit I

Introduction: Basic Concepts: Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics.

First law of Thermodynamics: Joule's experiment - first law of thermodynamics, corollaries-perpetual motion machines of first kind, first law applied to non-flow and flow process- limitations of first law of thermodynamics**.**

Applications: Thermometer, Thermal system analysis which involves heat and work transfer processes.

Learning outcomes:

At the end of this Unit, the student will be able to

- Identify thermodynamic systems, properties and their importance in solving engineering problems. (L3)
- Explain energy balance for closed systems and open systems. (L4)
- Solve simple thermodynamics problems. (L3)

Unit II

Second Law of Thermodynamics: Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility - Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency.

Entropy: Clausius inequality - Concept of Entropy- entropy equation for different processes and systems

Availability and Irreversibility: Definition of exergy and energy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes and irreversibility.

Applications: Refrigerators, heat pump and heat engines efficiency calculations

Learning outcomes:
At the end of this Unit, the student will be able to

- Apply second law of thermodynamics in design of heat engine, refrigerator and heat pump. (L3)
- Explain the efficiency of thermodynamic systems.(L2)
- Enumerate the causes for poor performance of thermodynamic systems. (L3)
- Apply entropy affects to estimate the performance of systems. (L3)
- Explain thermo-economics.(L3)

Unit III

Properties of Steam and use of Steam Tables: Pure Substances, P-V-T surfaces, T-s and h-s diagram, Mollier chart, dryness fraction, property tables, analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry.

Applications: To represent the grain–air–moisture system

Learning outcomes:
At the end of this Unit, the student will be able to

- Apply properties of steam to design steam systems. (L3)
- Examine steam systems using conservation equations. (L4)
- Evaluate the performance of steam systems. (L4)

Unit IV

Thermodynamic Relations: Maxwell relations, TdS equations, difference in heat capacities, ratio of heat capacities, Energy equation, Joule Thompson coefficient, Clausius-Clapeyron equation.

Air Standard Cycles: Otto, Diesel and dual cycles, P-V and T -S diagrams - description and efficiencies, mean effective pressures. Comparison of Otto, Diesel and dual cycles

Applications: IC engines

Learning outcomes:
At the end of this Unit, the student will be able to

- Explain the importance of T-ds equations. (L3)
- Relate specific heats, internal energy, enthalpy and Joule-Thomson coefficient in standard form. (L3)
- Examine the importance of compression ratio. (L4)
- Explain the cycles on which internal combustion engines work. (L3)

Unit V

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour, Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier's Equation – Psychrometric chart.

Applications: analysis of gas properties

Learning outcomes:
At the end of this Unit, the student will be able to

- Explain Psychrometric chart (L3)
- Calculate various psychrometric properties of air. (L3)

Text Book(s):

1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Yunus A. Cengel, Michaela A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011.

References:

1. J.B.Jones and G.A.Hawkins, Introduction to Thermodynamics, 2/e, John Wiley & Sons, 2012.
2. Moran, Michael J. and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 3/e, Wiley, 2015
3. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009
4. R.K. Rajput, S.Chand& Co., Thermal Engineering, 6/e, Laxmi publications, 2010.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2105	Machine Drawing	1	0	0	2.5

Course Objectives

- Identify the conventional representation of various components like bolts, nuts, screws etc.,
- Know the fastening arrangements such as welding, riveting the different styles of attachment for shaft.
- Prepare the assembly of various machine or engine components and miscellaneous machine components.

Course Outcomes

At the end of the course, student will be able to

1. Identify conventional representation of machine components. (L3)
2. Draw the sectional views of various machine parts (L3)
3. Construct the engine parts like Fuel pump, Petrol Engine connecting rod, piston assembly. (L3)
4. Draw the machine parts like Screws jacks, Machine Vices Plummer block, Tailstock. (L3)
5. Draw the Valves like spring loaded safety valve, feed check valve and air cock. (L3)

Machine Drawing Conventions :

Need for drawing conventions – introduction to IS conventions

a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.

b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.

c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.

d) Title boxes, their size, location and details - common abbreviations & their liberal usage

e) Types of Drawings – working drawings for machine parts.

PART-A

I. Drawing of Machine Elements and simple parts

Objective: To provide basic understanding and drawing practice of various joint, simple mechanical parts

Selection of Views, additional views for the following machine elements and parts with every drawing proportions.

a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.

b) Keys, cotter joints and knuckle joint.

c) Riveted joints for plates

d) Shaft coupling.

e) Journal, pivot and collar and foot step bearings.

PART-B

II. Assembly Drawings: Objective: The student will be able to draw the assembly from the individual part drawing.

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

a) Engine parts –Fuel pump Petrol Engine connecting rod, piston assembly.

b) Other machine parts - Screws jacks, Machine Vices Plummer block, Tailstock.

c) Valves: spring loaded safety valve, feed check valve and air cock.

Text Books:

1. Machine Drawing – N.Siddeswar, K.Kannaiah & V.V.S.Sastry - TMH
2. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers

References:

1. Machine Drawing – P.S.Gill,
2. Machine Drawing – Luzzader
3. Machine Drawing – Rajput
4. Machine Drawing – N.D. Junnarkar, Pearson
5. Machine Drawing – Ajeeth Singh, McGraw Hill
6. Machine Drawing – KC John, PHI
7. Machine Drawing – B Battacharya, Oxford
8. Machine Drawing – Gowtham and Gowtham, Pearson

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2106	Metallurgy & Mechanics of Solids Lab	0	0	3	1.5

Course Objectives:

1. To understand microstructure of engineering materials.
2. To explain grain boundary layers and grains size of different engineering materials.
3. To conduct Study the stress – strain relations of different materials.
4. To conduct uni-axial tension test on Steel, Aluminium, Copper and Brass
5. To determine the Brinnell's and Vicker's hardness numbers of different materials.
6. To Determine the Modulus of rigidity of different materials.

Course Outcomes:

The student is able to

1. Identify various microstructures of steels, cast iron. (L3)
2. Evaluate hardness of treated and untreated steels. (L4)
3. Understand the study the stress-strain relations of different materials.(L1)
4. Evaluate the hardness of different materials. (L3)
5. evaluate the Modulus of rigidity of different materials. (L3)

List of Experiments: Metallurgy Lab

1. Study of microstructure of pure metals – Iron, copper and aluminum.
2. Study of microstructure of low carbon steel, mild steel and high carbon steel.
3. Study of microstructure of cast irons.
4. Study of microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and their alloys.
5. Study hardenability of steels by Jominy End Quench Test.
6. Study of microstructure of heat treated steels.
7. Find hardness of various untreated and treated steels.

List of Experiments: Mechanics of Solids Lab

1. Study the stress – strain relations of (a) Mild Steel and (b) Tor Steel by conducting tension/compression test on U.T.M.
2. Study the stress – strain relation of (a) Copper (b) Aluminium (c) other materials by conducting tension /compression test.
3. Find the compressive and shear strength of wood and shear strength of GI sheet by conducting relevant tests.
4. Find the Brinnell's and Vicker's hardness numbers of (a) Steel (b) Brass (c) Aluminium (d) Copper.
5. Determine the Modulus of rigidity (a) Solid shaft (b) Hollow shaft made of steel and aluminium.
6. Find the spring index and modulus of rigidity of the material of a spring by conducting compression and tensile tests.
7. Determine the Young's modulus of the material by conducting deflection test on a simply supported, propped cantilever and continuous beams.
8. Find impact strength of a given material by conducting a) Charpy test and b) Izod test
9. Determine buckling load in a compressive member made with steel and aluminium.
10. Determine the deflection in leaf spring with a single leaf and multiple leafs.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2107	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5

Course Objectives:

- Explain the application of Bernoulli's equation in internal flows
- Familiarize with the performance of turbines and pumps
- Develop skill for measurement of pressure in external flows
- Gain knowledge in performance testing of hydraulic turbines at constant speed and head
- Gain knowledge in performance testing of hydraulic pumps at different working conditions.
- Analyze experimental results using formulas of work done, discharge power, efficiency, data tables, and graphs.

Course Outcomes

Upon the successful completion of course, students will be able to

1. Apply laws of conservation in verification of principles of fluid flow(L3)
2. Perform measuring of pressure, discharge and velocity of fluid flow(L3)
3. Evaluate major and minor losses in a pipe flow(L3).
4. Analyze the performance characteristics curves of different turbines and pumps(L4)
5. Analyze experimental results using formulas of work done, discharge power, efficiency, data tables, and graphs(L4).

LIST OF EXPERIMENTS

1. Calibration of Venturimeter
2. Calibration of Orifice meter
3. Resistance characteristics of pipes – friction factor.
4. Minor losses in pipes – sudden contraction/bends/valves
5. Impact of a jet on flat and curved plates
6. Performance characteristics of single centrifugal pump.
7. Performance characteristics of multi stage centrifugal pump.
8. Performance characteristics of reciprocating pump.
9. Performance characteristics of Pelton wheel turbine.
10. Performance characteristics of Francis turbine.

Subject Code	Subject Name	L	T	P	C
R19BSH-MC2101	Essence of Indian Traditional Knowledge	1	0	0	0

COURSE OBJECTIVES:

- Facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of knowledge system.(L2)
- Importing basic principle of thought process reasoning and inference sustainability of Indian traditional knowledge system(L2)
- Comprehend the legal framework, traditional knowledge, biological diversity act 2002 and geographical indication act 2003.(L3)
- Focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection.(L3)

COURSE OUTCOMES:

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

1. Knowledge about the concept of traditional knowledge and analyze social context(L2)
2. Apply significance of traditional knowledge protection (L3)
3. Analyze various enactments related to the protection of plant varieties. (L4)
4. Evaluate desired concepts of Intellectual property to protect the traditional knowledge(L4)
5. Compare the traditional knowledge in various sectors (L4)

Unit-I:

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

Learning Outcomes:

At the end of the unit the student will able to:

- Recognize the social change in traditional knowledge(L4)
- Contrast and compare characteristics importance kinds of traditional knowledge. (L2)
- Analyze physical and social contexts of traditional knowledge. (L4)

Applications: Compare and contrast the traditional knowledge with western knowledge.

Unit-II:

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Learning Outcomes:

At the end of the unit the student will able to:

- Identify the need of protecting traditional knowledge. (L2)
- Apply significance of TK protection. (L3)
- Analyze the value of TK in global economy. (L3)
- Evaluate the role of government in harnessing Traditional Knowledge. (L4)

Applications: Identify and implementation of Traditional Knowledge in present scenario.

Unit-III:

Legal framework and Traditional knowledge in Food: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PVPFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Importance of food – Styles of food-traditional food- Modern Food- Factors influencing food choice- Economic and Physical Determinants- Uniqueness of Culture in Food.

Learning Outcomes:

At the end of the unit the student will able to:

- Contrast and compare the Scheduled Tribes and other traditional forest dwellers(L2)
- Analyze plant variant protections and evaluate farmers right act(L4)
- Evaluate food security and protection of TK in the country(L5)

Applications: Establish an effective system for the protection of plant varieties and observe nutrition levels of traditional and modern food items

Unit-IV:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection- Legal concepts for the protection of traditional knowledge- Certain non IPR mechanisms of traditional knowledge protection- Patents and traditional knowledge- Strategies to increase protection of traditional knowledge- global legal FORA for increasing protection of Indian Traditional Knowledge.

Learning Outcomes:

At the end of the unit the student will able to:

- Evaluate strategies to increase the protection of Traditional Knowledge and Intellectual Property Rights (L4)
- Apply systems of Traditional Knowledge protection. (L3)
- Analyze legal concepts for the protection of Traditional Knowledge. (L4)

Applications: Case study to recognize legal concepts, protection of culture and Indian Traditional Knowledge.

Unit-V:

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture,

Learning Outcomes:

At the end of the unit the student will able to:

- Compare traditional knowledge in different sectors. (L2)
- Apply traditional knowledge in engineering. (L3)

Applications: Generate the report on Traditional and current methods of cultivation and observe yield levels

Reference Books:

1. Traditional Knowledge System in India, by AmitJha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, PratibhaPrakashan 2012.
3. Traditional Knowledge System in India by AmitJha Atlantic publishers, 2002
4. "Knowledge Traditions and Practices of India" KapilKapoor, Michel Danino

II Year –II Semester

Subject Code	Subject Name	L	T	P	C
R19BSH-MA2102	**Complex Variables, Probability and Statistics**	3	0	0	3

Course Objectives:

- To familiarize the learners with concepts of complex variables.
- To impart knowledge in basic concepts and few techniques in probability and statistics in relation to the engineering applications.

Course Outcomes:

At the end of the course, the student will be able to

1. Examine the analyticity of complex functions. (L3)
2. Evaluate complex integration using Cauchy's theorems and Cauchy's residue theorem. (L3)
3. Compute probabilities, theoretical frequencies using discrete and continuous probability distributions for real data. (L3)
4. Apply the concept of hypothesis test to large samples. (L3)
5. Apply statistical inferential methods to small samples. (L3)

UNIT I: Complex Variables and Analytic Functions (10 hours)

Functions of a complex variable, continuity, differentiation, analytic functions, Cauchy-Riemann equations, Milne-Thompson method, harmonic functions, harmonic conjugate.

Applications: Flow problems.

Learning Outcomes:

At the end of this unit, the student will be able to

- examine continuity and differentiability for complex functions. (L2)
- determine the analyticity using Cauchy-Riemann equations to complex functions. (L3)
- find the analytic function using Milne-Thompson method. (L3)

UNIT II: Complex Integration(All theorems without proofs) **(10 hours)**

Contour integrals, Cauchy theorem, Cauchy integral formula, Taylor's series, Laurent's series, zeros of analytic functions, singularities, residues, Cauchy residue theorem.

Applications: Evaluation of integrals of the type (a) Improper real integrals $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ (b) $\int_{-\infty}^{\infty} f(x)dx$ (c) $\int_{-\infty}^{\infty} e^{imx} f(x)dx$.

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate the Taylor and Laurent expansions of simple functions.(L2)
- determine the nature of the singularities of an analytic function. (L2)
- find the residues of an analytic function. (L2)
- apply Cauchy residue theorem to evaluate improper real integrals. (L3)

UNIT III: Probability (8 hours)

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem,.

The Random Variable: Random variable concept, distribution function, density function, Binomial distribution, Poisson distribution, Normal(Gaussian) distribution.

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate the probabilities of events on various random experiments. (L3)

- apply Baye's theorem to real time problems related to conditional probabilities.(L3)
- differentiate the properties in discrete and continuous probability distribution. (L2)
- apply Binomial and Poisson distributions for real data to compute probabilities, theoretical frequencies. (L3)
- interpret the properties of normal distribution and its applications. (L2)

Unit IV: Estimation and Testing of Hypothesis, large sample tests: (10 hours)

Estimation and Testing of Hypothesis: Introduction to Sampling, parameters, statistics, sampling distribution, point and interval estimation, formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors.

Large sample tests: Test for single proportion, difference of proportions, test for single mean and difference of means, confidence interval for parameters in one sample and two sample problems.

Learning Outcomes:

At the end of this unit, the student will be able to

- explain the concept of estimation, interval estimation and confidence intervals. (L2)
- apply the concept of hypothesis testing for large samples. (L3)

Unit V: Small Sample Tests (10 hours)

Student t-distribution (single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for single variance, $\chi 2$ - test for goodness of fit, ANOVA.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply the concept of testing hypothesis for small samples to draw the inferences. (L3)
- estimate the goodness of fit.(L3)

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44/e, 2017.
2. Veerarajan T., Probability, Statistics and Random Processes, 3rd edition, Tata McGraw-Hill, New Delhi, 2008.

References:

1. Erwin kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7/e, Mc-Graw Hill, 2004.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 2008.
4. Murray R. Spiegel,Seymour Lipschutz, John J. Schiller , Dennis Spellman,Schaum's Outline of Complex Variables, 2ed (Schaum's Outlines) 2nd Edition.
5. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying E. Ye, Probability and Statistics for Engineers and Scientists, 9th Edition, Pearson.
6. Miller and Freunds, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
7. S. C. Guptha and V. K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand and Sons Publications, 2012.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2201	Kinematics of Machinery	3	0	0	3

Course Objective:

- Explain the purpose of kinematics, Kinematic joint and mechanism and to study the relative motion of parts in a machine without taking into consideration the forces involved
- Get the knowledge on various mechanisms for straight line motion and their applications including steering mechanism
- Analyze the velocity and acceleration concepts and the methodology using graphical methods and principles and application of four bar chain and understand the application of slider crank mechanism etc. and study of plane motion of the body, The theories involved in cams. Further the students are exposed to the applications of cams and their working principles
- Understand gears, power transmission through different types of gears including gear profiles and its efficiency
- Impart various power transmission mechanisms and methodologies and working principles. Students are exposed to merits and demerits of each drive.

Learning outcomes:

After completion of this unit, students will be able to

1. Demonstrate the four bar, single slider and double slider mechanisms. **(L3)**
2. Demonstrate the lower pair mechanisms **(L3)**
3. Analyse the four bar, single slider and double slider mechanisms kinematically, cam profile by considering different types of velocities. **(L5)**
4. Design gears for power transmission **(L5)**
5. Analyze various power transmission systems such as belts, ropes ,chain drives and gear trains. **(L5)**

UNIT –I

MECHANISMS : Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained . Khubralrs criteria , Grashoff's law , Degrees of freedom, Kutzbach criterian for planar mechanisms, Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.
Applicaion: I.C Engines, J.C.B, Cams

Learning Outcomes:

After completion of this unit student will able to

1. Select the particular mechanism to machine or mechanism (L2)
2. Compute the reduction cost of manufacturing (L2)

UNIT –II

LOWER PAIR MECHANISM: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russul – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph. Conditions for correct steering – Davis Steering gear, Ackermans steering gear – velocity ratio; Hooke's Joint: Single and double – Universal coupling– application–problems.

Applications: Automobile, Electric locomotive

Learning Outcomes:

After completion of this unit student will able to

1. Select the particular mechanism for transmission systems (L1)

UNIT –III

KINEMATICS: Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Velocity and acceleration analysis of for a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration. Plane motion of body: Instantaneous center of rotation, centroids and axodes – relative motion between two bodies – Three centers in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

CAMS Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

Applications: I.C Engines, J.C.B, Cams, Printing press

Learning Outcomes:

After completion of this unit student will able to

1. Analyze the mechanisms in terms of velocity and acceleration.(L4)

UNIT –IV

Gears: Higher pairs, friction wheels and toothed gears–types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – Introduction to Helical, Bevel and worm gearing.

Applicaion: Automobile, Locomotives

Learning Outcomes:

After completion of this unit student will able to

1. Design the gears for transmission purposes (L5)

UNIT –V

Transmissions : Introduction, Belt and rope drives, selection of belt drive- Types of belt drives, V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt.

Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

Applications: Mills, Industries &Automobile

Learning Outcomes:

After completion of this unit student will able to

1. Design the transmission system with high efficiency (L5)

Text Books:

1. Theory of Machines / S.S Ratan/ Mc. Graw Hill Publ.2. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers

2. Theory of machines / Khurmi / S.Chand.

3. Theory of machines and Mechanisms – J.J Uicker, G.R.Pennock & J.E. Shigley - Oxford publishers.

References:

1. Theory of Machines Sadhu Singh Pearsons Edn

2. Theory of Machines / Shiegly / MGH 3. Machine Drawing – Rajput

3. Kinematics of Machinery through Hyper Works – J.S. Rao – Springer Publ.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2202	Applied Thermodynamics	3	0	0	3

Course Objectives

- Familiarize the developments in IC engines & understand combustion process in SI and CI engines.
- Introduce different types of compressors.
- Familiarize concepts of thermodynamics cycles used in steam power plants and gas turbines
- Impart knowledge on the working of nozzles, turbines, refrigeration and air conditioning.
- Evaluate the performance of basic cycles used in various refrigerating systems

Course Outcomes

At the end of the course, the student will be able to

1. Familiarize the developments in IC engines & understand combustion process in SI and CI engines.(L2)
2. Understand different types of compressors.(L2)
3. Familiarize concepts of thermodynamics cycles used in steam power plants and gas turbines(L2)
4. Impart knowledge on the working of nozzles, turbines, refrigeration and air conditioning.(L3)
5. Understand the Principles of Psychrometry, Air Conditioning and basic cycles of various refrigerating systems, their performance evaluation along with details of system components and refrigerant properties.(L3)

Unit I

IC Engines: Working and classification of IC engines, comparison of two stroke and four stroke engines, comparison of SI and CI Engines.

Combustion in IC Engines: SI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking, pre-ignition. CI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking. Fuel requirements and fuel rating.

Applications: Evaluation for efficiencies of IC engines

Learning outcomes:

After completion of this unit, students will be able to

- Understand working of IC engines on the basis of thermodynamic cycles. (L2)
- Estimate engine performance. (L5)
- Identify the effects of abnormal combustion in IC engines. (L3)

Unit II

Air compressors

Reciprocating Compressor: Single stage reciprocating compressors, work done, effect of clearance in compressors, volumetric efficiency, multi stage compressor, effect of inter cooling in multi stage compressors, compressor performance.

Rotary Compressor: Working principle of a rolling piston type compressor (fixed vane type), multi vane type compressors, and characteristics of rotary vane type compressor.

Applications: Refrigerators, Air conditioners

Learning outcomes:
After completion of this unit, students will be able to

- Classify different types of air compressors. (L2)
- Compare the performance of different types of air compressors (L2)

Unit III
Vapour Power Cycles: Vapour power cycle, simple Rankine cycle, mean temp of heat addition thermodynamic variables effecting efficiency and output of Rankine cycle.
Gas power Cycle: Simple gas turbine plant, Brayton cycle, closed cycle and open cycle for gas turbines, condition for maximum pressure ratio and optimum pressure ratio, actual cycle. Methods to improve performance: regeneration, inter-cooling and reheating. Introduction to jet propulsion: working principle of ramjet, turbojet, turbofan, turboprop and pulse jet engines

Applications: Power plants

Learning outcomes:
After completion of this unit, students will be able to

- Explain concepts of vapour power cycle used in steam power plant. (L2)
- Evaluate the cycles used in gas turbines. (L5)
- Outline the jet propulsion system (L2)

Unit IV
Nozzles: Type of nozzles - air and steam nozzles, Compressible flow through nozzle condition for maximum discharge - nozzle efficiency.
Steam Turbines: Classification of steam turbines -impulse turbine and reaction turbine - compounding in turbines - velocity diagrams in impulse and reaction turbines, efficiency, degree of reaction - governing of turbines

Applications: spray coatings, hydro power plants

Learning outcomes:
After completion of this unit, students will be able to

- Compare the performance of nozzles, used in turbines. (L2)
- Classify steam turbines and applications. (L4)
- Analyse the performance of steam turbines under different operating conditions. (L5)

Unit V
Refrigeration: Air refrigeration cycle-Bell-Coleman cycle –open and dense air systems-refrigeration system used in aircrafts and problems- vapour compression cycle, effect of vapour condition on COP of VCR, -vapour absorption cycle, properties of common refrigerants
Principles of Psychrometry and Air Conditioning: Psychometric terms, psychometric

processes and air conditioning systems-classification of air conditioning systems-working-problems-filters and humidifiers-classification-working.

Applications: Industries, Domestic Air conditioning systems etc.

Learning outcomes:
After completion of this unit, students will be able to

- Describe Psychometric properties & processes. (L2)
- Analyze various refrigerating cycles (L4)
- Evaluate the performance of various cycles. (L5)

Text Book(s)

1. Ganesan V, Internal Combustion Engines, Tata McGraw Hill, 2017.
2. M.L.Mathur and F.S.Mehta, Thermal Engineering, Jain brothers,2014

References:

1. Cengal Y.A and Boles M.A, Thermodynamics: An Engineering Approach, 5/e, McGraw-Hill, 2006.
2. Yahya, S. M., Turbines, Compressors and Fans, 4/e, Tata McGraw Hill, 2010.
3. Nag P.K, Engineering Thermodynamics, 4/e, Tata McGraw-Hill, 2008.
4. Onkar Singh, Thermal Turbomachines, 3/e, Wiley India, 2014.
5. P.L.Ballaney, Thermal Engineering, 2/e, Khanna, 2005.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2203	Production Technology	3	0	0	3

Course Objectives:

- Working principle of different metal casting processes and gating system.
- Classification of the welding processes, working of different types of welding processes and welding defects.
- Nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes.
- Principles of forging, tools and dies, working of forging processes.
- Classification, applications and manufacturing methods of plastics.
- Familiarize the steps in manufacturing of powder metallurgy parts

Course Outcomes:

At the end of the course, the student will be able to

1. Explain different metal casting processes and gating systems. (L2)
2. Evaluate the forces and power requirements in rolling process. (L5)
3. Apply the principles of various forging operations. (L3)
4. Classify working of various welding processes and outline the manufacturing methods of plastics, ceramics. (L2)
5. Demonstrate the application of plastics and power metallurgy. (L2)

UNIT I

Introduction: Importance and selection of manufacturing processes.

Casting Processes: Introduction to casting process, process steps; pattern: types, materials and allowance; Cores: Types of cores, core prints, principles and design of gating system; Solidification of casting: Concept, solidification of pure metal and alloy; Special casting processes: Shell casting, investment casting, die casting, centrifugal casting, casting defects and remedies.

Applications:

1. **Heavy Equipment** : Construction, farming and mining
2. **Defence :** Vehicles, artillery, munitions, storage and supporting equipment
3. **Hardware :** Plumbing industry pipes, joints, valves and fitting

Learning Outcomes:

At the end of this unit, the student will be able to

- Selection of suitable manufacturing process for a given product. (L3)
- Understand the steps involved in metal casting, pattern making. (L2)
- Apply the knowledge of designing gating systems, risers. (L3)
- Compare the working of various metal casting processes. (L4)
- Identify the various casting defects. (L3)

UNIT II

Metal Forming: Introduction, nature of plastic deformation, hot and cold working of metals, mechanics of metal forming; Rolling: Principle, types of rolling mill and products, roll passes, forces in rolling and power requirements; Extrusion: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, wire drawing, tube drawing.

Applications: Metal Forming can be used in to manufacture of piping and tubes, body panels, construction materials, electrical motors, doors, production of tubes and hollow pipes, frames, doors and windows

Learning Outcomes:

At the end of this unit, the student will be able to

- Compare cold working and hot working processes. (L4)

- Explain the working of rolling mills. (L2)
- Evaluate the forces and power in rolling and extrusion processes. (L5)

UNIT III

Forging: Principles of forging, tools and dies. Types: Smith forging, drop forging, forging hammers, rotary forging and forging defects. Sheet metal forming: Mechanics of sheet metal working, blanking, piercing, bending, stamping.

Applications:

- Aircraft Engines ,Airframe and auxiliary equipment
- Bearings, ball and roller
- Pumps and compressors, Steam Engines and turbines
- Pipeline fittings

Learning Outcomes:

At the end of this unit, the student will be able to

- Summarize the working of various extrusion processes. (L2)
- Identify the principles of forging, tools and dies. (L3)
- Summarize the various operations of Sheet metal forming. (L2)

UNIT IV:

Metal Joining Processes: Classification of welding processes, types of welds and welded joints and V-I characteristics, arc welding, weld bead geometry, submerged arc welding, gas tungsten arc welding, gas metal arc welding. applications, advantages and disadvantages of the above processes, other fabrication processes. Heat affected zones in welding; soldering and brazing: Types and their applications, Welding defects: causes and remedies.

Applications:

1. Welding of tubes and pipes, chains, LPG cylinders and other items.
2. Fabrication of Steel furniture, gates, doors and door frames, and body
3. Manufacturing white goods such as refrigerators, washing machines

Learning Outcomes:

At the end of this unit, the student will be able to

- Classify the working of various welding processes. (L2)
- Compare V-I characteristics of different welding processes. (L4)
- Summarize the applications, advantages of various welding processes. (L2)
- Identify the defects in welding. (L3)

UNIT V:

Plastics: Types, properties and their applications, processing of plastics, extrusion of plastics, transfer molding and compression molding, injection molding, thermoforming, rotational molding and blow molding

Powder Metallurgy: Principle manufacture of powders, steps involved.

Applications:

1. Manufacturing white goods such as refrigerators, washing machines

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn the methods of manufacturing plastics parts. (L2)
- Demonstrate the application of power metallurgy. (L2)

Text Books:

1. Rao P.N., Manufacturing Technology – Volume I, 5/e, McGraw-Hill Education, 2018.
2. Kalpakjain S and Schmid S.R., Manufacturing Engineering and Technology, 7/e, Pearson, 2018.

Reference Books:

3. Millek P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 4/e, John Wiley and Sons Inc, 2010.
4. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.
5. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1st Edition, Springer, 2010.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2204	Instrumentation & Control Systems	3	0	0	3

Course Objectives:
The course focuses on imparting the principles of measurement which includes the working mechanism of various sensors and devices that are in use to measure the important physical variables of various mechatronic systems

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

1. Explain the principles of measurements. (L2)
2. Measure the temperature and pressure of various instruments. (L4)
3. Measure the flow, speed of various instruments (L4)
4. Calibrate the strain using strain gauge.
5. Explain the elements of control systems. (L2)

UNIT – I
Definition – Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. dynamic performance characteristics – sources of error, classification and elimination of error.
Measurement of Displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.
Applications: precision measuring devices
Learning Outcomes:
At the end of this unit, the student will be able to

- Measure the displacement using various instruments.

UNIT – II
MEASUREMENT OF TEMPERATURE: Classification – ranges – various principles of measurement – expansion, electrical resistance – thermister – thermocouple – pyrometers – temperature indicators.
MEASUREMENT OF PRESSURE: Units – classification – different principles used. manometers, piston, bourdon pressure gauges, bellows – diaphragm gauges. low pressure measurement – thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.
Applications: pressure gages, temperature indicators in boilers, pressure vessels etc.
Learning Outcomes:
At the end of this unit, the student will be able to

- Calibrate the pressure, temperature of various instruments.

UNIT – III
MEASUREMENT OF LEVEL: Direct method – indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubler level indicators.
FLOW MEASUREMENT: Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser Doppler anemometer (LDA).
MEASUREMENT OF SPEED: Mechanical tachometers – electrical tachometers – stroboscope, noncontact type of tachometer Measurement of Acceleration and Vibration:

Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle.
Applications: turbine, pumps etc
Learning Outcomes:
At the end of this unit, the student will be able to

- Calibrate the level, flow, speed of various instruments

UNIT – IV
STRESS STRAIN MEASUREMENTS : Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes.
MEASUREMENT OF HUMIDITY – Moisture content of gases, sling psychrometer, absorption psychrometer, dew point meter.
MEASUREMENT OF FORCE, TORQUE AND POWER- Elastic force meters, load cells, torsion meters, dynamometers.
Applications: dynamometers
Learning Outcomes:
At the end of this unit, the student will be able to

- Calibrate the strain ruing strain gauge.

UNIT – V
ELEMENTS OF CONTROL SYSTEMS : Introduction, importance – classification – open and closed systems, servomechanisms–examples with block diagrams–temperature, speed & position control systems.
Applications: Control systems in various mechanisms
Learning Outcomes:
At the end of this unit, the student will be able to

- Understand the elements of control systems
-

Text Books:
1. Measurement Systems: Applications & design / D.S Kumar/
2. Mechanical Measurements / BeckWith, Marangoni,Linehard, Pearson
References:
1. Measurement systems: Application and design/Doeblin Earnest. O. Adaptation/ TMH
2. Experimental Methods for Engineers / J.P.Holman/McGraw Hill
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation, measurement & analysis / B.C.Nakra & K.K.Choudhary/TMH

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2205	Design of Machine Members	3	0	0	3

Course Objectives:

The objectives of the course are to

1. The student shall gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity
2. Selection of proper materials to different machine elements based on their physical and mechanical properties.
3. Learn and understanding of the different types of failure modes and criteria.
4. Procedure for the different machine elements such as fasteners, shafts, couplings, keys, axially loaded joints etc.

Course outcomes:

At the end of the course, the student will be able to

1. Apply the design procedure to engineering problems, including the consideration of technical and manufacturing constraints.(L4)
2. Select suitable materials and significance of tolerances and fits in critical design applications. (L5)
3. Design the elements for strength, stiffness and fatigue. (L4)
4. Identify the loads, the machine members subjected and calculate static and dynamic stresses to ensure safe design.(L1)
5. Identify various types of stresses induced in couplings and ensure a safe design. (L1)

UNIT – I

INTRODUCTION: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design, tolerances and fits –BIS codes of steels.

STRESSES IN MACHINE MEMBERS: Simple stresses – combined stresses – torsional and bending stresses – impact stresses – stress strain relation – various theories of failure – factor of safety – design for strength and rigidity – preferred numbers. the concept of stiffness in tension, bending, torsion and combined situations – static strength design based on fracture toughness.

Applications: In design of Automobiles , Mechanical Components etc..

Learning Outcomes:

- Explain the basic design considerations(L2)
- Understand the various codes of steels(L2)
- Explain various stresses in different machine members(L2)

UNIT – II

STRENGTH OF MACHINE ELEMENTS: Stress concentration – theoretical stress concentration factor – fatigue stress concentration factor notch sensitivity – design for fluctuating stresses – endurance limit – estimation of endurance strength – Goodman's line – Soderberg's line – modified Goodman's line.

Applications: In design of Automobiles , Mechanical Components etc..

Learning Outcomes:

- Identify various stresses for the cause of fracture(L1)
- Explain about the factors of safety(L2)

UNIT – III

Riveted and welded joints – design of joints with initial stresses – eccentric loading.

Bolted joints – design of bolts with pre-stresses – design of joints under eccentric loading – locking devices – both of uniform strength, different seals.

Applications: In construction of bridges, Assembles of automobiles etc

Learning Outcomes:

- Identify various stresses induced in design of weld joints(L1)
- Explain the design of bolts(L2)
- Explain various types of weld joints(L2)

UNIT – IV

KEYS, COTTERS AND KNUCKLE JOINTS: Design of keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints- knuckle joints.

SHAFTS: Design of solid and hollow shafts for strength and rigidity – design of shafts for combined bending and axial loads – shaft sizes – BIS code. Use of internal and external circlips, gaskets and seals (stationary & rotary).

Applications: In Automobile Industry etc

Learning Outcomes:

- Explain about design of shafts and other members(L2)
- Explain about the considerations of tolerances in the design of shafts(L2)
- Explain the various loads to be considered in design of shafts(L2)

UNIT – V

SHAFT COUPLING: Rigid couplings – muff, split muff and flange couplings.

MECHANICAL SPRINGS

Stresses and deflections of helical springs – extension -compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – co-axial springs, leaf springs.

Applications: In heavy Trucks, four wheelers, etc

Learning Outcomes:

- Explain the design considerations for shaft couplings(L2)
- Identify the loads and stresses induced in couplings(L1)
- Explain about the design procedure for springs(L2)

Note: Design data book is NOT Permitted for examination

Text Books:

1. Machine Design/V.Bandari/ TMH Publishers
2. Machine design / NC Pandya & CS Shah/Charotar Publishing House Pvt. Limited
3. Design data book of Engineers-

References:

1. Design of Machine Elements / V.M. Faires/McMillan
2. Machine design / Schaum Series/McGrawHill Professional
3. Machine Design/ Shigley, J.E/McGraw Hill.
4. Design data handbook/ K.Mahadevan & K. Balaveera Reddy/ CBS publishers.
5. Design of machine elements-Spotts/Pearson Publications
6. Machine Design –Norton/ Pearson publishers

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2206	Production Technology Lab	0	0	3	1.5

Course Objectives:

- Acquire practical knowledge on Metal Casting, Welding, Press Working and Processing of Plastics.

Course Outcomes:

At the end of the lab, the student will be able to

1. Exercise for Strength and Permeability for sand.(L4)
2. Design the Gating and pouring time and solidification time calculations.(L4).
3. Fabricate different types of components using various welding techniques (L6).
4. Perform Blanking and Piercing operation with Simple, Compound and Combination dies.(L6)
5. Perform the Plasma arc cutting, Wire cut EDM and exercise Additive manufacturing with reverse engineering. (L6)

1. METAL CASTING

a) Gating Design and pouring time and solidification time calculations.
b) Sand Properties Testing – Exercise for Strength and Permeability.
c) Molding, Melting and Casting for ferrous/ non ferrous materials.

2. WELDING

a) TIG Welding.
b) MIG Welding.
c) Friction stir welding
d) Any other Special Welding Processes.

3. MECHANICAL PRESS WORKING

a) Press Tool: Blanking and Piercing operation with Simple, Compound and Combination dies.
b) Closed die forging, Deep Drawing and Extrusion operations.

4. UN CONVENTIONAL MANUFACTUNRING PROCESSES

a) Electro Discharge Machining(EDM)/ Wire cut EDM
b) Plasma arc cutting / Abrasive jet machining (AJM)
c) Additive manufacturing with reverse engineering.

Subject Code	Subject Name	L	T	P	C
R19MEC-PC2207	Instrumentation & Control Systems Lab	0	0	3	1.5

Course Objectives:

1. To Measurement of various linear, angular dimensions of the products and flatness of the surface by using precision measuring instruments.
2. To Learn how to check various parameters of the threads and gears.
3. To Selection of the appropriate measuring instruments
4. To Knowledge of the requirement of calibration and errors in measurement and perform accurate measurements
5. To Alignment various machines used in manufacturing

Course outcomes:

The student should be able to

1. Measurement of various linear, angular dimensions of the products and flatness of the surface by using precision measuring instruments.
2. Learn how to check various parameters of the threads and gears.
3. Selection of the appropriate measuring instruments
4. Knowledge of the requirement of calibration and errors in measurement and perform accurate measurements
5. Alignment various machines used in manufacturing

. **INSTRUMENTATION LAB**

1. Calibration of pressure gauge.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge.
5. Calibration of thermocouple.
6. Calibration of capacitive transducer.
7. Study and calibration of photo and magnetic speed pickups.
8. Calibration of resistance temperature detector.
9. Study and calibration of a rotameter.
10. Study and calibration of Mcleod gauge for low pressure

Subject Code	Subject Name	L	T	P	C
R19BSH-MC2204	English for Competitive Exams	0	0	3	0

Course Objectives

- Aims to help learners develop their English language skills, particularly those planning to appear for Competitive Exams that test their English Language abilities.
- Presents a wider scope for gaining the power of expression through rich Vocabulary to get placed well.
- Imparts critical reading strategies for comprehension of complex texts
- Provides training and opportunities to develop fluency in English through participation in formal group discussions and Self Introductions.
- Demonstrates good writing skills for effective Paragraph Writing, Essay Writing and formal correspondence through Emails.
- Encourages use of a wide range of grammatical structures, Phrases, Clauses and Idioms in speech and writing.

Unit 1

Vocabulary: How to talk about actions. Using and Identifying Parts of Speech in Syntax and Semantic Patterns accurately. Writing skills for effective Paragraph Writing and formal correspondence through Emails. Participating in formal Group discussions and doing Self-introductions.

Learning Outcomes

At the end of the module, the learner will be able to

- use rich vocabulary in any formal competitive setting.(L2)
- identify parts of speech and use them flawlessly in both Speech and Writing (L3)
- introduce themselves unhesitatingly (L3)
- participate confidently in any formal discussion, in particular, Group Discussions (L3)
- exude confidence in Speech and Writing(L2)
- write paragraph effectively (L3)
- produce logically coherent expressions with accurate and acceptable thoughts (L3)
- write Emails legibly in formal correspondence.(L4)

Unit 2

Vocabulary: How to talk about various speech habits.Learning Verb forms, Tenses and Subject-verb agreement and using them accurately in both Speaking and Writing contexts. Writing skills Essay Writing and formal correspondence through Emails. Participating in formal Group discussions and doing Self-introductions.

Learning Outcomes

- At the end of the module, the learner will be able to
- comprehend Verb forms appropriately (L2)
- optimise Tenses contextually (L3)
- speak effectively using right Tense and forms of the Verbs (L2)
- understand Subject-verb agreement and use the right form of the Verb that suits the Subject (L3)
- write paragraph effectively (L3)
- produce logically coherent expressions with accurate and acceptable thoughts (L3)
- write Emails legibly in formal correspondence.(L4)

Unit 3 8 Hours (2L+6P)

Vocabulary: How to insult your enemies. Learning various Grammatical Structures i.e. Voice, Degrees of Comparison, Reported Speech, and the like that meet the current

Competitive needs. Writing skills for formal correspondence through Emails. Participating in formal Group discussions and doing Self-introductions.

Learning Outcomes

- At the end of the module, the learner will be able to
- identify Voice, know its importance and use it in sentences (L2)
- understand the significance of Passive voice in formal situations. (L3)
- comprehend complex structures of Degrees of Comparison (L2)
- know Reported Speech, its structure and its usage in Speech and Writing(L3)
- use a wide range of grammatical structures (L2)
- write paragraph effectively (L3)
- produce logically coherent expressions with accurate and acceptable thoughts (L3)
- write Emails legibly in formal correspondence.(L4)

Unit 4

Vocabulary: How to flatter your friends. Reading Comprehension passages through Skimming and Scanning and understanding the gist or the specific purpose of them. Identifying the Common errors and Correction of Sentences. Writing skills for effective formal correspondence through Emails. Participating in formal Group discussions and doing Self-introductions.

Learning Outcomes

At the end of the module, the learner will be able to

- comprehend a passage and know its gistL3)
- understand the specific purpose of the passage, using reading techniques (L2)
- develop advanced reading skills for a deeper understanding of texts (L3)
- avoid errors in both Speech and Writing (L2)
- identify the errors in sentences and correct them. (L2)
- write paragraph effectively (L3)
- produce logically coherent expressions with accurate and acceptable thoughts (L3)
- write Emails legibly in formal correspondence.(L4)

Unit 5

Vocabulary: High-frequency words for all competitive exams.Understanding Phrase, Clause, and Idiom and using them with examples properly for the execution of the needs of Competitive Exams. Writing skills for effective formal correspondence through Emails. Participating in formal Group discussions and doing Self-introductions.

Learning Outcomes

At the end of the module, the learner will be able to

- understand Phrase in detail and its use in sentence(L3)
- know Clause , its types and usage in sentence (L2)
- understand what Idiom is and its importance in both Speech and Writing (L2)
- use grammatically correct structures with a wide range of Phrases,Clauses and Idioms (L3)
- write paragraph effectively (L3)
- produce logically coherent expressions with accurate and acceptable thoughts (L3)
- write Emails legibly in formal correspondence.(L4)

Reference Books

1. Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.

2. Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
3. Skilful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)