Branch: MECHANICAL	Year: III	Semester: Odd
Subject Code: NHU-501	Subject Name: Engineering Economics	
Course Outcomes:	1. Understand the basic principles, scope and the applications of Engineering Economics	
	2. Understand and apply the knowledge of elasticity of demand and supply on price determination.	
	3. Apply the knowledge of demand forecasting to make effective demand forecast.	
	4. Understand the complexity of uncertain market structure and be able to take decisions of price determinations.	
	5. Understand the various management concepts and thoughts and using for better resource management.	
	6. Understand the basic principles, scope and the applications of Engineering Economics	
Syllabus: As per AKTU		
Unit 1	**Unit-1 Introduction to Engineering Economics and Managerial Economics** Concept of Efficiency, Theory of Demand , Elasticity of Demand, Supply and Law of Supply indifference Curves, Budget Line, Welfare Analysis, Scope of Managerial Economics, Techniques and Applications of Managerial Economics.	
Unit 2	**Unit-2 Market Structure** Perfect Competitions Imperfect- Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.	
Unit 3	**Unit-3 Demand Forecasting and cost Estimation** Characteristics of Forecasts, Forecasting Horizons, Steps to Forecasting, Forecasting Methods, Seasonal Adjustments, Forecasting Performance Measures, Cost Estimation, Elements of cost, Computation of Material Variances Break-Even Analysis.	
Unit 4	**Unit-4 Management Aspects** Functions of Management, Project Management, Value Engineering, Project Evaluation, Decision Making.	

Branch: MECHANICAL	Year: III	Semester: Odd
Subject Code: NME-501	Subject Name: Machine Design-I	
Course Outcomes:	1. Understand the design requirements and follow the general procedure for designing machine elements.	
	2. Understand the modes of failure and related theories of failure.	
	3. Design a machine element against fluctuating loads .	
	4. Understand various design aspects of riveted joints	
	5. Design machine shafts, keys and couplings	

	subjected to twisting moment and/or bending moment
	6. Design helical springs and screw jack.
Syllabus: As per AKTU	
Unit 1	**Introduction** Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads. **Design for Static Load** Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure.
Unit 2	**Design for Fluctuating Loads** Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria. **Riveted Joints** Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint.
Unit 3	**Shafts** Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity. **Keys and Couplings** Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Design of rigid and flexible couplings.
Unit 4	**Mechanical Springs** Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading. **Power Screws** Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack

Branch: MECHANICAL	Year: III	Semester: Odd
Subject Code: NME-502	Subject Name: Kinematics of Machines	
Course Outcomes:	1. Explain fundamental concepts of kinematics of machines.	
	2. Analyze the motion of different mechanisms using relative velocity and instantaneous centre method.	
	3. Conduct kinematic synthesis of four bars and slider crank mechanism using graphical methods.	
	4. Construct, analyze and evaluate the cam profile for different motions of followers.	
	5. Determine the gear geometry and design various	

	types of gear trains. 6. Analyze and evaluate friction drives viz. belt and rope, pivot & collar bearing, and clutches.
Syllabus: As per AKTU	
Unit 1	**Unit I** Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain. **Velocity analysis:** Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, rubbing velocity at a pin joint, instantaneous center method, types and locations of instantaneous center, Kennedy's theorem, velocities in four bar mechanism and slider crank mechanism.
Unit 2	**Acceleration analysis:** Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism, Klein's construction for slider crank mechanism and four bar mechanism, analytical method for slider crank mechanism. **Kinematic synthesis of mechanism:** Introduction, dimensional synthesis of mechanisms, motion, path and function generation, Chebyshev spacing, three position synthesis, graphical approach for four link mechanisms, straight line mechanisms, special mechanisms – indicator diagram mechanisms, steering mechanisms, Hook's Joint.
Unit 3	**Cams** Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration, simple harmonic and cycloidal motions of follower. Analytical methods for cam profile.
Unit 4	**Gears and gear trains** Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, interference and undercutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.
Unit 5	**Friction drives** Introduction, belt and rope drives, open and crossed belt drives, velocity ratio, slip, power transmission, effect of mass of belt on power transmission, maximum power transmission, initial tension and maximum tension, pivots and collars, uniform pressure and uniform wear, clutches.

Branch: MECHANICAL	Year: III	Semester: Odd
Subject Code: NME-503	Subject Name: Manufacturing Science & Technology-II	
Course Outcomes:	1. Understand the basics of raw material transformation, its requisite elements and their	

	economic feasibility.
	2. Analyze various transformation tools, their basic mechanisms as well as their accessories.
	3. Analyze pre-assembly operations and measuring tools for transformation processes.
	4. Impose various permanent fastening techniques as well as their physics.
	5. Understand latest transformation processes and their applications.
	6. Impose different latest permanent fastening techniques.
Syllabus: As per AKTU	
Unit 1	**Metal Cutting** Mechanics of metal cutting.Geometry of tool and nomenclature .ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Heat generation and cutting tool temperature, Cutting fluids/lubricants.Tool materials. Tool wear and tool life. Machinability.Dynamometer, Brief introduction to machine tool vibration and surface finish.Economics of metal cutting.
Unit 2	**Machine Tools** (i) Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout (ii) Shaper, slotter, planer: Construction, operations & drives. (iii) Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. (iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.
Unit 3	**Grinding &Super finishing** (i) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding.Centerless grinding (ii) Super finishing: Honing, lapping and polishing. **Limits, Fits & Tolerance and Surface roughness:** Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness
Unit 4	**Metal Joining (Welding)** Survey of welding and allied processes.Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters.Resistance welding - spot, seam projection etc.Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Thermodynamic and Metallurgical aspects in welding and weld, Weldability, Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ.

Unit 5	**Introduction to Unconventional Machining and Welding** Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding. Introduction to Hybrid machining processes

Branch: MECHANICAL	Year: III	Semester: Odd
Subject Code: NME-504	Subject Name: Heat & Mass Transfer	
Course Outcomes:	1. Analyze and apply the laws of conduction, convection and radiation heat transfer phenomenon.	
	2. Understand and solve problems related to heat transfer through extended surfaces and that to transient conduction.	
	3. Understand and analyze the natural and forced convection heat transfer process.	
	4. Understand thermal radiation and related laws.	
	5. Understand and apply LMTD and NTU methods for evaluating effectiveness of heat exchangers.	
	6. Understand the phenomenon of mass transfer, condensation and boiling.	
Syllabus: As per AKTU		
Unit 1	**Introduction to Heat Transfer:** Thermodynamics and Heat Transfer. Modes of Heat Transfer: Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. **Conduction :** General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems. Initial and boundary conditions. **Steady State one-dimensional Heat conduction:** Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Concept of thermal resistance. Analogy between heat and electricity flow; Thermal contact resistance and over all heat transfer coefficient; Critical radius of insulation.	
Unit 2	**Fins:** Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. **Transient Conduction:** Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts.	
Unit 3	**Forced Convection:** Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Thermal entrance region, Empirical heat transfer relations; Relation	

	between fluid friction and heat transfer; Liquid metal heat transfer. **Natural Convection:** Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere, Combined free and forced convection.
Unit 4	**Thermal Radiation :** Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.
Unit 5	**Heat Exchanger :** Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. **Condensation and Boiling:** Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convection boiling. **Introduction to Mass Transfer:** Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.

Branch: MECHANICAL	Year: III	Semester: Odd
Subject Code: NME-505	Subject Name: I.C. Engines & Compressors	
Course Outcomes:	1. Understand the Air standard and Air fuel cycles and their thermodynamic analysis.	
	2. Understand the phenomena of combustion in SI Engine, carburetion, Ignition system and supercharging.	
	3. Understand the phenomena of combustion in CI Engine and Injection system used in CI engines.	
	4. Understand the cooling and lubrication system for S.I/C.I. engines.	
	5. Understand various aspects related to selection of suitable fuels for S.I./C.I. engines.	
	6. Understand and analyze compressors and blowers.	
Syllabus: As per AKTU		
Unit 1	Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram. Thermodynamic analysis of Air standard cycles, Otto cycle, Diesel cycle,	

	Dual cycle, Stirling cycle, Ericsson cycles, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.
Unit 2	SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines. Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition, Scavenging in 2 Stroke engines, Supercharging and its effect.
Unit 3	CI Engine: Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines. Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings Exhaust emissions from SI engine and CI engine and it's control.
Unit 4	Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. Fuels: Fuels for SI and CI engine , Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines
Unit 5	Compressors: Classification, Reciprocating compressors, Single and Multi stage compressors, Intercooling, Volumetric efficiency. Rotary compressors, Classification, Centrifugal compressor , Axial compressors, Surging and stalling, Roots blower, Vaned compressor.