JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF MECHANICAL ENGINEERING

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	BSC	Vector Calculus & Fourier Transforms	3	--	--	3
2	PCC-ME	Mechanics of Solids	3	--	--	3
3	PCC-ME	Material Science & Metallurgy	3	--	--	3
4	PCC-ME	Production Technology	3	--	--	3
5	PCC-ME	Thermodynamics	3	--	--	3
6	PCC-ME	Machine Drawing	1	--	3	2.5
7	PCC-Lab1	Metallurgy & Mechanics of Solids Lab	--	--	3	1.5
8	PCC-Lab2	Production Technology Lab	--	--	3	1.5
9	MC2101	Environmental Science	3	--	--	--
10	PROJ-2101	Socially Relevant Project				0.5
		Total Credits	**19**	--	**9**	**21**

II YEAR II SEMESTER

S.No	Course Code	Course Title	L	T	P	Credits
1	BSC	Complex Variables & Statistical Methods	3	--	--	3
2	PCC-ME	Kinematics of Machinery	3	--	--	3
3	PCC-ME	Applied Thermodynamics	3	--	--	3
4	PCC-ME	Fluid Mechanics & Hydraulic Machines	3	--	--	3
5	PCC-ME	Metal Cutting & Machine Tools	3	--	--	3
6	PCC-ME	Design of Machine Members-I	3	--	--	3
7	PCC-Lab5	Fluid Mechanics & Hydraulic Machines Lab	--	--	3	1.5
8	PCC-Lab6	Machine Tools Lab	--	--	3	1.5
9	MC2201	Essence of Indian Traditional Knowledge	2	--	--	--
		Total Credits	**20**	--	**6**	**21**

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II Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COMPLEX VARIABLES & STATISTICAL METHODS					

Course Objectives:

- To familiarize the complex variables.
- To familiarize the students with the foundations of probability and statistical methods.
- To equip the students to solve application problems in their disciplines.

Course Outcomes: At the end of the course students will be able to

- apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
- find the differentiation and integration of complex functions used in engineering problems (L5)
- make use of the Cauchy residue theorem to evaluate certain integrals (L3)
- apply discrete and continuous probability distributions (L3)
- design the components of a classical hypothesis test (L6)
- infer the statistical inferential methods based on small and large sampling tests (L4)

UNIT – I: Functions of a complex variable and Complex integration:

Introduction – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.
Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs).

UNIT – II: Series expansions and Residue Theorem:

Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series.
Types of Singularities: Isolated – pole of order m – Essential – Residues – Residue theorem (without proof) – Evaluation of real integral of the type $\int_{-\infty}^{\infty} f(x)dx$

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UNIT – III: Probability and Distributions:
Review of probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT – IV: Sampling Theory:
Introduction – Population and samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Introduction to t, χ^2 and F-distributions – Point and Interval estimations – Maximum error of estimate.

UNIT – V: Tests of Hypothesis:
Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **Miller and Freund's,** Probability and Statistics for Engineers, 7/e, Pearson, 2008.

Reference Books:

1. **S. C. Gupta and V. K. Kapoor**, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
2. **Jay l. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
3. **Shron L. Myers, Keying Ye, Ronald E Walpole,** Probability and Statistics Engineers and the Scientists, 8th Edition, Pearson 2007.
4. **Sheldon, M. Ross**, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation, 2011

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		3	**0**	**0**	**3**
KINEMATICS OF MACHINERY					

Course objective: The students completing this course are expected to understand the nature and role of the kinematics of machinery, mechanisms and machines. The course includes velocity and acceleration diagrams,analysis of mechanisms joints, Cams and their applications. It exposes the students to various kinds of power transmission devices like belt,rope , chain and gear drives and their working principles and their merits and demerits**.**

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.

Grashoff's law , Degrees of freedom ,Kutzbach criterian for planar mechanisms, Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversions of quadric cycle chain – single and double slider crank chains.

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.

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, Klein's construction, determination of Coriolis component of acceleration.

PLANE MOTION OF BODY: Instantaneous center of rotation, centroids and axodes – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

UNIT – IV

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.

Analysis of motion of followers: Roller follower – circular cam with straight, concave and convex flanks.

BELT DRIVES: 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, Chains- length, angular speed ratio, classification of chains.

UNIT – V

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.

GEAR TRAINS : 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.

TEXT BOOKS:

1. Theory of Mechanisms & Machines by Jagadeesh lal, Metropolitan Pvt.Ltd.
2. Theory of Machines by Thomas Bevan/ CBS Publishers

REFERENCES:

1. Theory of Machines – S. S Rattan- TMH Publishers
2. Theory of machines and Machinery-Vickers - Oxford .
3. Theory of Mechanisms and machines – A.Ghosh & A.K.Malik – East West Press Pvt. Ltd.
4. Kinematics and dynamics of Machinery- R.L Norton- TATA McGraw-Hill

Course outcomes:

The student should be able to

CO1: Contrive a mechanism for a given plane motion with single degree of freedom.
CO2: Suggest and analyze a mechanism for a given straight line motion and automobile steering motion.
CO3: Analyze the motion (velocity and acceleration) of a plane mechanism.
CO4: Suggest and analyze mechanisms for a prescribed intermittent motion like opening and closing of IC engine valves etc.
CO5: Select a power transmission system for a given application and analyze motion of different transmission systems

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		3	0	0	3

APPLIED THERMODYNAMICS

Course objectives:
This course is intended to study the thermodynamic analysis of major components of Rankine cycle, refrigeration cycles and compressible fluids and to analyze the energy transfers and transformations in these components including individual performance evaluation.

UNIT – I
VAPOUR POWER CYCLES: Carnot, Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating.
COMBUSTION: Fuels and combustion, concepts of heat of reaction, adiabatic flame temperature, Stoichiometry, flue gas analysis.

UNIT II
BOILERS : Classification – working principles of L.P & H.P boilers with sketches – mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – Draught: classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.
UNIT – III
STEAM NOZZLES: Function of a nozzle – applications - types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow - its effects, degree of super saturation and degree of under cooling, Wilson line.
STEAM TURBINES: Classification – impulse turbine; mechanical details – velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-laval turbine - methods to reduce rotor speed-velocity compounding, pressure compounding and velocity & pressure compounding, velocity and pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency
UNIT IV
REACTION TURBINE: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency – calculation of blade height.
STEAM CONDENSERS: Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump, cooling water requirement.
UNIT – V
COMPRESSORS – Classification –Reciprocating type, Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, saving of work, minimum work condition for two stage compression.

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Rotary (Positive displacement type)
Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.
Rotary (non positive displacement type)
Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, velocity diagrams.
Axial Flow Compressors: Mechanical details and principle of operation, velocity diagrams.

TEXT BOOKS:
1. Basics & Applied Thermodynamics- P.K.Nag – 4th edition- McGraw Hill
2. Applied Thermodynamics - R Yadhav

REFERENCES:
1. Thermal Engineering- Mahesh Rathore - TataMcGrawHill
2. Heat Engineering (MKS and SI units) - VP Vasandani& DS Kumar - Metropolitan books
3. Thermal Engineering - Sadhu Singh- Pearson Publishers
4. Applied Thermodynamics - Eastop & McConkey- Pearson 5th Edn
5. Fluid Mechanics Fundementals and Applications - Y.A.Cengel, J.M.Cimbala- McGrawHill
6. Thermal Engineering-M.L.Marthur & Mehta- Jain bros. Publishers
7. Thermal Engineering - RK Rajput- Lakshmi Publications

Course outcomes:
CO1**:** Expected to learn the working of steam power cycles and also should be able to analyze and evaluate the performance of individual components
CO2: Student is able to learn the principles of combustion , stochiometry and flue gas analysis
CO3: Students will be able to design the components and calculate the losses and efficiency of the boilers, nozzles and impulse turbines**.**
CO4: Students will be able to design the components and calculate the losses and efficiency of reactions turbines and condensers.
CO5: Student is able to learn various types of compressors, principles of working and their performance evaluation.

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		3	**0**	**0**	**3**
FLUID MECHANICS & HYDRAULIC MACHINES					

Course Objectives: The students completing this course are expected to understand the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Further, the student shall be able to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

UNIT I

Objective: After studying this unit student will know the concept of fluid and its properties, manometry, hydrostatic forces acting on different surfaces and also problem solving techniques.

Fluid statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws.

Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.

UNIT II

Objective: In this unit student will be exposed to the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.

Fluid kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow.

Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend.

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

UNIT III

Objective: At the end of this unit student will be aware of the concepts related to boundary layer theory, flow separation, basic concepts of velocity profiles, dimensionless numbers and dimensional analysis.

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles.

Dimensional Analysis: Dimensions and Units, Dimensional Homogeneity, Non dimensionalization of equations, Method of repeating variables and Buckingham Pi Theorem.

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UNIT IV

Objective: In this unit student will know the hydrodynamic forces acting on vanes and performance evaluation of hydraulic turbines.

Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube- theory- functions and efficiency.

UNIT V

Objective: After studying this unit student will be in a position to understand the* characteristic curves of hydraulic turbines and also *evaluate the performance characteristics of hydraulic pumps.

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems- hydraulic ram, hydraulic lift, hydraulic coupling. Fluidics – amplifiers, sensors and oscillators. Advantages, limitations and applications.

Centrifugal pumps: classification, working, work done – manometric head- losses and efficiencies- specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH.

Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

TEXT BOOKS:

1. Fluid Mechanics- Fundementals and Applications by Y.A. Cengel, J.M.Cimbala, 6th Edn, McGrawHill
2. Fluid Mechanics - Dixon, 7th Edn, Elesvier

REFERENCE BOOKS:

1. Hydraulics, fluid mechanics and Hydraulic machinery- Modi and Seth
2. Fluid Mechanics and Hydraulic Machines - RK Bansal- Laxmi Publications (P) Ltd.
3. Fluid Mechanics and Hydraulic Machines - Rajput
4. Fluid Mechanics and Fluid Power Engineering - D.S. Kumar, Kotaria & Sons.
5. Fluid Mechanics and Machinery - D. Rama Durgaiah, New Age International.

COURSE OUTCOMES:

From this course the student is expected to learn
CO1: The basic concepts of fluid properties.
CO2: The mechanics of fluids in static and dynamic conditions.
CO3: Boundary layer theory, flow separation and dimensional analysis.
CO4: Hydrodynamic forces of jet on vanes in different positions.
CO5: Working Principles and performance evaluation of hydraulic pump and turbines.

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II Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
METAL CUTTING & MACHINE TOOLS					

Course objectives:
1. The course provides students with fundamental knowledge and principles in material removal processes.
2.In this course, the students apply the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, and drill presses, Computer Numerical Control etc
3. To demonstrate the fundamentals of machining processes and machine tools.
4. To develop knowledge and importance of metal cutting parameters.
5. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
6. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

UNIT – I
FUNDAMENTAL OF MACHINING:
Elementary treatment of metal cutting theory – element of cutting process – Single point cutting tools, nomenclature of single point cutting tool, tool signature, tool angles, mechanism of metal cutting, types of chips and chip formation – built up edge and its effects, chip breakers, mechanics of orthogonal and oblique cutting –Merchant's force diagram, cutting forces, velocity ratio, cutting speeds, feed, depth of cut, tool life, Taylor's tool life equation, simple problems - Tool wear, tool wear mechanisms, heat generation in metal cutting, coolants, machinability, economics of machining, tool materials and properties.

UNIT – II
LATHE MACHINES:
Introduction- types of lathe - Engine lathe – principle of working - construction - specification of lathe - work holders and tool holders – accessories and attachments – lathe operations – taper turning methods and thread cutting – drilling on lathes – cutting speed and feed - constructional features of speed gear box and feed gear box - turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout- principal features of automatic lathes – classification – single spindle and multi-spindle automatic lathes – tool layout and cam design for automats.

UNIT – III
SHAPING, SLOTTING AND PLANNING MACHINES: Introduction - principle of working – principle parts – specifications - operations performed - slider crank mechanism - machining time calculations.

DRILLING & BORING MACHINES: Introduction – construction of drilling machines – types of drilling machines - principles of working – specifications- types of drills – geometry of twist drill - tool holding devices - operations performed – tool holding devices – cutting speed and feed – machining time calculations - Boring Machines – fine Boring Machines – jig boring machines - deep hole Drilling Machines.

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UNIT – IV

MILLING MACHINES: Introduction - principle of working – specifications – milling methods - classification of Milling Machines – principle features of horizontal, vertical and universal Milling Machine, machining operations, types of cutters - geometry of milling cutters – methods of indexing, accessories to milling machines - cutting speed and feed – machining time calculations.

UNIT –V

FINISHING PROCESSES: Introduction - theory of grinding – classification of grinding machines- cylindrical and surface grinding machines- tool and cutter grinding machines- different types of abrasives- bonds, specification and selection of a grinding wheel-lapping, Honing & Broaching operations- comparison to grinding.

TEXT BOOKS:

1. Manufacturing Engineering and Technology -Kalpakjian S & Steven R Schmid/Pearson Publications 7th Edition
2. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill

REFERENCES:

1. Metal cutting and machine tools /Geoffrey Boothroyd, Winston A.Knight/ Taylor & Francis
2. Production Engineering/K.C Jain & A.K Chitaley/PHI Publishers
3. Technology of machine tools/S.F.Krar, A.R. Gill, Peter SMID/ TMH
4. Fundamentals of modern manufacturing – Mikell P Groover – John Wiley & sons -5th edition

Course Outcomes:

CO1: Learned the fundamental knowledge and principals in material removal process.
CO2: Acquire the knowledge on operations in conventional, automatic, Capstan and turret lathes
CO3: capable of understanding the working principles and operations of shaping, slotting, planning , drilling and boring machines.
CO4: able to make gear and keyway in milling machines and understand the indexing mechanisms
CO5: Understand the different types of unconventional machining methods and principles of finishing processes.

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		3	**0**	**0**	**3**
DESIGN OF MACHINE MEMBERS – I					

Course Objectives:

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. Able to select proper materials to different machine elements based on their physical and mechanical properties.
3. Learn and understand of the different types of failure modes and criteria.
4. Procedure for the different machine elements such as fasteners, shafts, couplings, keys, axially know loaded joints etc.
5. To be able to know standards in design.

UNIT – I

INTRODUCTION: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design–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.

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, Gerber's parabola.

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 – bolts of uniform strength.

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.

UNIT – IV

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).

SHAFT COUPLING: Rigid couplings – muff, split muff and flange couplings: rigid flanged coupling, protected rigid flanged coupling, Bushed pin type flexible coupling.

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UNIT – V
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.
Note: Design data book is NOT Permitted for examination

TEXT BOOKS:
1. Machine Design/ Shigley, J.E/McGraw Hill
2. Machine Design/V.B.Bhandari/ McGrawHill Education

REFERENCES:
1. Machine design / Schaum Series/McGrawHill Professional
2. Machine Design / Norton/ Pearson publishers
3. Machine design / NC Pandya & CS Shah/Charotar Publishing House Pvt. Limited

COURSE OUTCOMES:
Students must be able to
1. Calculate different stresses in the machine components subjected to various static loads, failures and suitability of a material for an engineering application.
2. Calculate dynamic stresses in the machine components subjected to variable loads.
3. Design riveted, welded, bolted joints, keys, cotters and knuckle joints subjected to static loads and their failure modes
4. Design the machine shafts and suggest suitable coupling for a given application.
5. Calculate stresses in different types of springs subjected to static loads and dynamic loads.

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		0	**0**	**3**	**1.5**
FLUID MECHANICS & HYDRAULIC MACHINERY LAB					

Course Objective: To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Turbine flow meter.

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		0	**0**	**3**	**1.5**
MACHINE TOOLS LAB					

Course objectives:
The students are required to understand the parts of various machine tools and operate them. They are required to understand the different shapes of products that can be produced on these machine tools.

1. Introduction of general purpose machines -Lathe, Drilling machine, Milling machine, Shaper, Planing machine, Slotting machine, Cylindrical grinder, Surface grinder and Tool and cutter grinder.
2. Operations on Lathe machines
   (i) Step turning and Knurling
   (ii) Taper turning and Knurling
   (iii) Thread cutting and knurling
   (iv) Drilling and tapping
3. Operations on Drilling machine
   (i) Drilling, reaming and tapping
   (ii) Rectangular drilling
   (iii) Circumferential drilling
4. Operations on Shaping machine
   (i) Round to square
   (ii) Round to Hexagonal
5. Operations on Slotter
   (i) Keyway (T –slot)
   (ii) Keyway cutting
6. Operations on milling machines
   (i) Indexing
   (ii) Gear manufacturing

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II Year - II Semester		**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE					

Course Objectives:
To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system

- The course aim of the importing basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledge system
- To understand the legal framework and traditional knowledge and biological diversity act 2002 and geographical indication act 2003
- The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection
- To know the student traditional knowledge in different sector

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

- Understand the concept of Traditional knowledge and its importance
- Know the need and importance of protecting traditional knowledge
- Know the various enactments related to the protection of traditional knowledge
- Understand the concepts of Intellectual property to protect the traditional knowledge

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:

- Understand the traditional knowledge.
- Contrast and compare characteristics importance kinds of traditional knowledge.
- Analyze physical and social contexts of traditional knowledge.
- Evaluate social change on traditional 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:

- Know the need of protecting traditional knowledge.
- Apply significance of tk protection.
- Analyze the value of tk in global economy.
- Evaluate role of government

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UNIT III

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.

Learning Outcomes:

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

- Understand legal framework of TK.
- Contrast and compare the ST and other traditional forest dwellers
- Analyze plant variant protections
- Evaluate farmers right act

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:

- Understand TK and IPR
- Apply systems of TK protection.
- Analyze legal concepts for the protection of TK.
- Evaluate strategies to increase the protection of TK.

UNIT V

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

Learning Outcomes:

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

- Know TK in different sectors.
- Apply TK in engineering.
- Analyze TK in various sectors.
- Evaluate food security and protection of TK in the country.

Reference Books:

1) Traditional Knowledge System in India, by Amit Jha, 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 Amit Jha Atlantic publishers, 2002
4) "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

e-Resources:

1) https://www.youtube.com/watch?v=LZP1StpYEPM
2) http://nptel.ac.in/courses/121106003/