TECHNO INDIA UNIVERSITY

WESTBENGAL

EM 4, Sector V, Salt Lake, Kolkata-700091, West Bengal, India
Phone: +91 9836544416/17/18/19, Fax: +91 33 2357 1097

4-Year Bachelor of Technology (B.Tech.) Curriculum and Syllabus for Mechanical Engineering (ME)

Fifth Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIUSD-501	Career Advancement & Skill Development-V	2	1	0	3
TIUME-501	Kinematics of Machines	2	1	0	3
TIUME-502	Heat Transfer	3	1	0	4
TIUME-503	Metal Cutting and Machine Tools	2	1	0	3
TIUME-504	Material Science and Engineering	2	1	0	3
TIUME-505	Fluid Machinery-I	2	1	0	3
Practical					
TIUME-591	AutoCAD Laboratory	0	0	3	2
TIUME-592	Heat Transfer Laboratory	0	0	3	2
TIUME-593	Fluid Machinery Laboratory	0	0	3	2
Sessional					
TIUCSL-581	Entrepreneurship Skill Development-V	0	0	3	2
Total Credits					27

Approved By:

External Expert   VC   Registrar   Dean of Academics   Mentor of the Dept.   HOD

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Syllabus

Kinematics of Machines

TIUME-502

L-T-P: 2-1-0   **Credit: 3**

Review of velocity analysis: (resolution & composition, instantaneous axis and relative velocity methods) and acceleration analysis (graphical & analytical methods), Kennedy's theorem, analytical treatment by using complex notation, Lagrangian co-ordinates.

Linkage: 4-bar linkage, space linkage, Freudenstein equation, crank & rocker mechanism, drag link mechanism, non-parallel crank linkage, automobile steering mechanism, slider-crank mechanism, swinging block mechanism, oscillating arm quick return mechanism, icicles linkage, elliptic trammel, toggle mechanism, straight line mechanism, pantograph, universal joint, etc.

Transmission of motion by direct contact: pitch point, angle of action, pressure angle, conjugate curves.

Bodies in pure rolling contact.

Cam & follower: plate cam, cylindrical cam – displacement, velocity & acceleration diagram, analytical treatment in the design of different types of cams.

Gears: Law governing profile of gear tooth, analysis of tooth profile foe circular and non-circular gears for fixed centre distance, interference, minimum no. of teeth, gear tooth of involute & cycloid profile, spur gear, bevel gear, rack & pinion, worm gear.

Gear train: differential gear train, epicyclic gear train, bevel gear differential of automobile.

Belt drive: open & cross belt, quarter twist belt, stepped pulley, equal stepped pulley, guide pulley, crowning of pulley.

Chain drive. Differential screw, Compound screw.

Geneva wheel mechanism, intermittent motion from continuous motion.

Recommended books

1. Theory of Machines by S.S. Rattan, McGraw Hill Education (India) Private Limited.

2. Theory of Machines: Kinematics and Dynamics by Sadhu Singh, Pearson Education.

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3. Theory of Machines (Kinematics) by V. Ravi, PHI.

4. Theory of Machines by R.S. Khurmi and J.K. Gupta, S. Chand.

5. Theory of Mechanisms and Machines by A. Ghosh and A.K. Mallik, East-West Press.

Heat Transfer

TIUME-503

L-T-P: 3-1-0   **Credit: 4**

Introduction: Heat and Thermodynamics. Modes of heat transfer. Combined heat transfer processes.

Conduction: Fourier law of heat conduction for isotropic material. Thermal conductivity. Derivation of general heat conduction equation. Non-dimensionalisation - thermal diffusivity and Fourier number. Types of boundary conditions. Solution of steady one dimensional conduction problem with and without heat generation. Analogy with electrical circuits. Critical thickness of insulation. Fins-rectangular and pin fins. Fin effectiveness and efficiency. Lumped parameter approach and significance of time constant. Biot number. Solution of 1-D transient heat conduction equation without generation using product solution.

Radiation: Physical mechanism of thermal radiation. Laws of radiation. Definition of black body, emissive power, radiation intensity, reflectivity, transmissivity. Radiosity and irradiation. Radiation exchange between black bodies Concept of grey surface. Exchange between grey-diffuse-isotropic surfaces by radiation network method. Radiation shielding.

Convection: Introduction. Newton's law of cooling and significance of heat transfer coefficient. Momentum and energy equation in two-dimensions. Non-dimensionalisation and significance of non-dimensional quantities. Scale analysis for flow over flat-plate. Velocity and thermal boundary layer thickness by integral method. Natural convection-effect of coupling on the conservation equation. One dimensional solution for Couette and Poiseuille flow. Concept of developing and developed flow. Correlations in forced convection for external and internal flows. Natural convection over a vertical flat-plate.

Heat exchangers: Types of heat exchangers. Introduction to LMTD. Correction factor. Fouling factor. Effectiveness-NTU method for heat exchangers, rating and sizing.

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Recommended Books:

1. Principles of Heat and Mass Transfer by F.P. Incropera, D.P. Dewitt, T.L. Bergman and A.S. Lavine, Wiley India Pvt. Ltd.

2. Heat and Mass Transfer by Y.A. Cengel and A.J. Ghajar, McGraw Hill Education (India) Private Limited.

3. Heat and Mass Transfer by P.K. Nag, McGraw Hill Education (India) Private Limited.

4. Heat Transfer by J.P. Holman, McGraw Hill Education (India) Private Limited.

5. Fundamentals of Heat and Mass Transfer by M. Thirumaleshwar, Pearson India.

Metal Cutting and Machine Tools

TIUME-504

L-T-P: 2-1-0   **Credit: 3**

Theory of metal cutting: tool geometry, specification, conversion and selection; basic mechanisms and geometry of chip formation of orthogonal cutting, continuous and discontinuous chips, built up edge; mechanics of metal cutting, theory, measurement of shear angle; tool dynamometer; thermal aspects of metal cutting; weld theory of friction and action of metal cutting fluids, tool wear and tool life; economics of machining.

Machine tool: features of construction; layout of speed for various machine tool drives; introduction to hydraulic and electric drives; design of gear boxes for speed and feed changes; rigidity and vibration analysis.

Numerical control machine tools: basic concepts, field of applications, coordinate system and machine motions, types of NC systems, MCU and other components, NC part programming- manual and computer assisted; engineering analysis; CNC, DNC.

Basic concepts of open loop, closed loop and adaptive control systems.

Recommended Books:

1. Manufacturing Technology: Metal Cutting and Machine Tools by P.N. Rao, McGraw Hill Education (India) Private Limited.

2. A Course in Workshop Technology Vol. 2 by B.S. Raghuwanshi, Dhanpat Rai & Co.

3. Elements of Workshop Technology Vol. 2 by S.K. Hajra Choudhury, A.K. Hajra Choudhury and Nirjhar Roy, Media Promoters.

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Material Science and Engineering

TIUME-505

L-T-P: 2-1-0   **Credit: 3**

Structure: Crystal structure of materials, crystal systems, unit cells and space lattices, miller indices of planes and directions, packing geometry in metallic, ionic and covalent solids. Imperfections in crystalline solids and their role in influencing various properties.

Diffusion: Fick's laws and application of diffusion in sintering, doping of semiconductors and surface hardening of metals.

Mechanical Properties: stress-strain diagrams of metallic, modulus of elasticity, yield strength, tensile strength, toughness, elongation, plastic deformation, viscoelasticity, hardness, impact strength, creep, fatigue, ductile and brittle fracture.

Electronic Properties: Concept of energy band diagram for materials – conductors, semiconductors and insulators, electrical conductivity effect of temperature on conductivity, intrinsic and extrinsic semiconductors, dielectric properties.

Metals and Alloys: Solid solutions, solubility limit, phase rule, binary phase diagrams, intermediate phases, intermetallic compounds, iron carbide phase diagram, heat treatment of steels; cold and hot working of metals; recovery, recrystallization and grain growth; microstructure, properties and applications of ferrous and non-ferrous alloys.

Ceramics: Structure, properties, processing and applications of traditional and advanced ceramics.

Polymers: Classification, polymerization, structure and properties, additives for polymer products, processing and applications.

Composites: Powder Metallurgy; Properties and applications of various composites.

Introduction to Advanced Materials and Tools: Smart materials, exhibiting ferroelectric, piezoelectric, optoelectric, nanomaterials, synthesis, properties and applications, biomaterials, superalloys, shape memory alloys. Materials characterization techniques.

Environmental Degradation: Corrosion and oxidation of materials, prevention.

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Recommended Books:

1. Callister's Materials Science and Engineering by R. Balasubramaniam, Wiley.

2. Material Science and Metallurgy by U.C. Jindal, Pearson Education.

3. Materials Science by M.S. Vijaya and G. Rangarajan, McGraw Hill Education (India) Private Limited.

4. Materials Science and Engineering: A First Course by V. Raghavan, PHI.

FLUID MACHINERY-I

TIUME-506

L-T-P: 2-1-0   **Credit: 3**

Introduction: Definition, Classification and Application of fluid machines.

Turbomachines: Classification and constructional Features: Incompressible and compressible flow machines, Pump, Turbines and Compressor. Radial, axial and mixed flow type machines; Impulse and reaction turbines; Impeller, volute casing, diffuser, runner and inlet guide vane. Principles of Energy Transfer, Euler one dimensional pump and turbine equations, Euler head, Bernoulli's equation, Rotor work and efficiency for incompressible flow turbomachines, Velocity diagrams for radial and axial flow machines, Blade twist. Different heads and efficiencies for pumps, fans and turbines.

Special Devices: Analysis of flow through propellers and windmills, Slipstream and actuator disc theory; Jet propulsion devices, Analysis of thrust and other performance parameters; Jet pump.

Positive Displacement Pumps: Reciprocating and rotary Pumps, Working principle and indicator diagram for reciprocating pump, Air vessel.

Recommended Books:

1. Hydraulic Machines by K. Subramanya, McGraw Hill Education (India) Private Limited.

2. Hydraulic Machines including Fluidics by J. Lal, Metropolitan Book Co.

3. Fluid Mechanics and Thermodynamics of Turbomachinery by S.L. Dixon, Elsevier India Pvt. Ltd.

4. A Treatise on Turbomachines by G.C. Gopalakrishnan, Scitech Publications.

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AutoCAD Laboratory

TIUME-591

L-T-P: 0-0-3   **Credit: 2**

Computer Aided Design: Solutions of design problems using AutoCAD software. Application to solid modeling.

Application of FEM in typical design problems.

Use of typical optimization technique in design.

Heat Transfer Laboratory

TIUME-592

L-T-P: 0-0-3   **Credit: 2**

Study of conduction heat transfer and determination of thermal conductivity.

Study of heat transfer through a fin and determination of fin performance parameters.

Study of forced convective heat transfer and determination and validation of heat transfer coefficient and Nusselt number.

Study of free convective heat transfer and determination and validation of heat transfer coefficient and Nusselt number.

Study of various types of heat exchangers, like shell and tube heat exchanger, plat heat exchanger, tubular heat exchanger etc. Determination of heat exchanger performance parameters.

Study of radiative heat transfer: determination of emissivity of gray surface, determination of Stefan-Boltzmann constant.

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Fluid Machinery Laboratory

TIUME-593

L-T-P: 0-0-3   **Credit: 2**

Study on the performance test of centrifugal pump, gear pump, reciprocating pump, pumps in series and parallel operation.

Performance test of Pelton, Francis and Kaplan turbine in off-grid and on-grid condition.

Performance test of centrifugal blower, fan and compressor.

Study on pump cavitation.