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)

Fourth Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIUSD-401	Career Advancement & Skill Development-IV	2	1	0	3
TIUMTH-402	Probability and Statistics	3	0	0	3
TIUME-401	Fluid Mechanics-II	3	1	0	4
TIUME-402	Thermodynamics-II	2	1	0	3
TIUME-403	Mechanics of Materials	2	1	0	3
TIUME-404	Casting, Forming and Welding	2	1	0	3
TIUMTH-407	Numerical Analysis	3	0	0	3
Practical					
TIUME-491	Machine Drawing Practice	0	0	3	2
TIUME-492	Applied Mechanics Laboratory	0	0	3	2
Sessional					
TIUCSL-481	Entrepreneurship Skill Development-IV	0	0	3	2
Total Credits					28

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

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Syllabus

Probability and Statistics

TIUMTH-402

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

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence.

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev's inequality.

Special Distributions: Discrete uniform, Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions. Functions of a Random Variable.

Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation, independence of random variables, bivariate normal distribution.

Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions.

Fluid Mechanics-II

TIUME-403

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

Turbulent Flow: Basic concept of turbulence and turbulent flow.

Dynamics of Viscous Flows: Equation of motion for viscous flow – two-dimensional laminar flow between flat parallel plates and annulus.

Boundary Layer Theory: concept of boundary layer, boundary layer thickness, displacement thickness, momentum thickness, growth of boundary layer; Prandtl's boundary layer equations, Von Karman's momentum integral equation for a boundary layer, skin

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friction drag coefficient for laminar and turbulent boundary layer; boundary layer in pipe flow, friction velocity; separation of boundary layer, form drag, method of drag reduction; lift and drag on submerged bodies, aerofoils, stalling of aerofoils.

Compressible Flow: review of thermodynamic principles for perfect gases, adiabatic and isentropic relations; steady flow energy equation; speed of propagation of a small disturbance through a compressible fluid, sonic velocity, Mach number, Mach cone and Mach wave; isentropic flow, stagnation properties of a compressible flow, isentropic pressure, temperature and density ratios; compressibility correction factor in the measurement of air speed; area – velocity relationship for compressible flow through a variable area duct, mass flow rate through a duct, critical condition and choking; flow through convergent-divergent nozzle, over expansion and under expansion, performance of propulsive nozzles; normal shock, normal shock relations.

Flow of Ideal Fluids: rotation of a fluid particle, vorticity, rotational and irrotational motion; velocity potential function, circulation, stream function, flow net; governing equation for two dimensional irrotational motion, simple two dimensional irrotational flows like uniform flow, plane source, plane sink etc.; superposition of simple irrotational flows, combination of a source and a sink, combination of uniform flow and a source (Rankine half body), combination of a uniform flow and a source-sink pair (Rankine oval), doublet and its strength, superimposition of an uniform flow and a doublet (flow past a stationary cylinder); vortex motion –free and forced vortex, strength of a vortex; combination of a uniform flow, doublet and a free vortex (flow over a rotating cylinder), Magnus effect, Kutta-Joukowski's theorem.

Principles of Physical Similarity and Dimensional Analysis: Concept and types of physical similarity; Dimensional analysis and Buckingham Pi theorem; similarity and model studies.

Recommended books

1. Fluid Mechanics by F.M. White, McGraw Hill Education (India) Private Limited.

2. Fluid Mechanics by R.W. Fox, A.T. McDonald and P.J. Pritchard, Wiley.

3. Introduction to Fluid Mechanics and Fluid Machines by S.K. Som, G. Biswas and S. Chakraborty, McGraw Hill Education (India) Private Limited.

4. Textbook of Fluid Mechanics and Hydraulic Machines by Sukumar Pati, McGraw Hill Education (India) Private Limited.

5. Fluid Mechanics: Including Hydraulic Machines by A.K. Jain, Khanna.

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Thermodynamics-II

TIUME-404

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

Vapour Power Cycles: Carnot cycle, Rankine cycle, Reheat cycle, Regenarative cycles with open and closed Feed Water Heaters. Availability analysis of cycles.

Gas Power Cycles: Air Standard Cycles– Otto, Diesel, Dual, Stirling, Brayton cycles. Gas turbine cycles with intercooling, reheating and regeneration. Use of air tables for gas power cycle analysis.

Refrigeration Cycles: Vapour Compression Refrigeration cycles, Vapour Absorption Refrigeration cycles, P-h chart, Air Refrigeration cycle.

Cogeneration and Combined Cycles: Binary vapour cycle, Cogenerative cycles, Combined Gas Vapour cycles.

Thermodynamics of Mixtures: Mixture of ideal gases, Mixture of ideal gas and vapour, Laws of thermodynamics for gas-vapour mixtures, Psychrometry, Thermodynamic analysis of psychrometric processes, Thermodynamic relations for multi-component systems.

Fuels and Combustion: Fuels, Air requirements, Analysis of Combustion products, enthalpy of formation, Calculation of enthalpy of combustion and adiabatic flame temperature, HHV and LHV of fuels, Second law analysis of chemically reacting systems.

Chemical and Phase Equilibrium: Criteria for equilibrium, Equilibrium between multi-component and multi-phase systems, Gibbs phase rule, Metastable equilibrium, Chemical equilibrium, Determination of equilibrium composition and equilibrium temperature in chemically reacting systems. Ionization.

Recommended Books:

1. Thermodynamics: An Engineering Approach by Y.A. Cengel and M.A. Boles, McGraw Hill Education (India) Private Limited.

2. Fundamentals of Thermodynamics by C. Borgnakke and R.E. Sonntag, Wiley.

3. Thermodynamics by M.C. Potter, C.W. Somerton and SukumarPati, Tata McGraw Hill Education.

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4. Engineering Thermodynamics by P.K. Nag, McGraw Hill Education (India) Private Limited.

5. Basic Engineering Thermodynamics by R. Joel, Pearson Education.

Mechanics of Materials

TIUME-405

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

Concept of stress and strain : Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety; normal strain, shear strain, Hooke's law, Poisson's ratio, generalized Hooke's law; analysis of axially loaded members.

Torsion: Torsion of cylindrical bars, torsional stress, modulus of rigidity and deformation, torsion of closely coiled helical springs.

Beam Bending: Shear and moment in beams; load, shear and moment relationship; shear and moment diagrams; flexure formula; shear stress in beams; differential equation of the elastic curve, deflection of beams, direct integration method, moment area method, method of superposition, Castigliano's theorems for statically determinate and indeterminate beams.

Analysis of thin-walled pressure vessels and thick cylinders

Transformation of stress and strain: Transformation of stress and strain, principal stresses, principal strains, Mohr's circle for stress and strain.

Combined loading: Axial and torsional; axial and bending; axial, torsional and bending.

Columns: Buckling of slender columns, Euler bucking load for different end conditions.

Recommended Books:

1. Elements of Strength of Materials by S.P. Timoshenko and D.H. Young, East West Press

2. Strength of Materials by D. Nag and A. Chanda, Wiley-India.

3. Mechanics of Materials by R.C. Hibbeler, Pearson Education.

4. Mechanics of Materials by F.P. Beer, E.R. Johnston, J.T. Dewolf and D.F. Mazurek, McGraw Hill Education (India) Private Limited.

5. Strength of Materials by S. Ramamrutham, R. Narayanan, Dhanpat Rai Publications.

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Casting, Forming and Welding

TIUME-406

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

Casting: The basic idea, patterns, moulding materials - properties and mould making; various casting processes; cores, gating and risering; foundry furnaces; special casting methods; casting defects, inspection and repair.

Forming: hot and cold working; rolling; forging and forging dies; drawing, deep drawing; extrusion; bending; coining, hubbing, embossing, thread rolling, tube piercing etc.; HERF processes; press working etc.; Defects in metal working.

Welding and joining processes: classifications; gas welding; flame cutting; arc welding- electric arc welding -theory of heat generation, power source selection, arc structure, arc characteristic; metal transfer in arc welding; different are welding processes- SMAW, Carbon Arc Welding, Atomic Hydrogen Welding, MIG, TIG, CO_2- MIG, FCAW; other welding processes like ESW, EBW, PAW, USW, Explosion Welding etc.; welding consumables; characteristics of weldment; welding defects and inspection; welding of non-traditional materials; Introduction to newer processes of welding; soldering and brazing.

Recommended Books:

1. Manufacturing Technology: Foundry, Forming and Welding by P.N. Rao, Tata Mcgraw Hill Education Private Limited.

2. Manufacturing Processes for Engineering Materials by S. Kalpakjian and S.R. Schmid, Pearson Education.

3. Welding and Welding Technology by R.L. Little, McGraw-Hill Education (India) Pvt. Limited.

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Numerical Analysis

TIUMTH-407

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

Module 1: Errors and approximations: Error type, Analysis and Estimation, Error Propagation.

Module 2: Numerical Solution of Algebraic & Transcendental Equations: Bisection Method, Regula Falsi Method, Newton- Raphson Method, Secant Method.

Module 3: Interpolation with Equal and Unequal Intervals: Finite difference, difference of polynomial in Factorial notation, Other difference operator, Newton's Forward and Backward interpolation formula, Central interpolation formula, Stirling's formula, Bessel's formula, Lagrange's formula and Newton's Divided difference interpolation formula.

Module 4: Solution of simultaneous algebraic equations by Gauss elimination method, Gauss-Jordan method, iterative methods of solutions, Jacobi method, Gauss- Siedel method, relaxation method.

Module 5: Numerical differentiation, Numerical integration – Newton-Cote's Quadrature Formula, Trapezoidal Rule, Simpson's Rules, Weddle's Rule, Principle of least square, Curve Fitting Linear & non linear, exponential, logarithmic curve.

Module 6: Picard's method, Taylor's series method, Euler's methods, Euler's modified method, Runge kutta fourth order method, Predictor-corrector method, Adams- Bashforth Method, Milne's method.

Machine Drawing Practice

TIUME-491

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

Thread profile, nuts & bolts, stud, riveted joint, welded joint, hooks/cotter/knuckle joint, pulley, shaft coupling (rigid/flexible), stuffing box, Plummer Block.

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Applied Mechanics Laboratory

TIUME-492

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

Simple experiments of Mechanics and Strength of Materials – Moment of inertia of flywheel, spring testing, tension, torsion, bending tests, Hardness tests, impact tests etc.