Faculty of Engineering & Technology

P.K.University

Shivpuri (MP)

Department of Mechanical Engineering

Evaluation Scheme & Syllabus for
B.Tech. Second Year
(III & IV Semester)

(Effective from session 2025-26)

STUDY AND EVALUATION SCHEME FOR B.TECH MECHANICAL ENGINEERING

SEMESTER-III

SUBJECT CODE	SUBJECTS NAME	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	T	P		Th	Pr	Tot	Th	Pr	Tot	
UENGIME301	Engineering Mathematics-III	3	1	0	4	30	-	30	70	-	70	100
UFLUIME302	Fluid Mechanics	3	0	0	3	30	-	30	70	-	70	100
UMATEME303	Material Science	3	0	0	3	30	-	30	70	-	70	100
UMECHME304	Mechanics of Solids	3	0	0	3	30	-	30	70	-	70	100
UTHERME305	Thermodynamics	3	1	0	4	30	-	30	70	-	70	100
UENVIME306	Environment & Ecology	3	0	0	3	30	-	30	70	-	70	100
UFLUIME307	Fluid Mechanics Lab	0	0	2	1	-	25	25	-	25	25	50
UMATEME308	Material Science Lab	0	0	2	1	-	25	25	-	25	25	50
UTHERME309	Thermodynamics Lab	0	0	2	1	-	25	25	-	25	25	50
Total		18	2	6	23	180	75	255	420	75	495	750

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II Year III Semester

UENGIME301
ENGINEERING MATHS–III

L	T	P
3	1	0

UNIT I

Numerical Techniques – I: Zeroes of transcendental and polynomial equations, Bisection method, Regula-falsi method, Newton-Raphson method, Rate of convergence of above methods.

Interpolation: Finite differences, Newton‟s forward and backward interpolation. Lagrange‟s and Newton‟s divided difference formula for unequal intervals.

UNIT II

Numerical Techniques –II: Solution of system of linear equations, Matrix Decomposition methods, Jacobi method, Gauss- Seidal method.

Numerical differentiation & Integration: Trapezoidal rule, Simpson‟s one third and three-eight rules, Solution of ordinary differential equations (first order, second order and **simultaneous) by Euler‟s, Picard‟s and fourth**-order Runge- Kutta methods.

UNIT III

Statistical Techniques: Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves, Correlation, Linear, non – linear and multiple regression analysis, Binomial, Poisson and Normal distributions. Tests of significations: Chi-square test, t-test.

UNIT IV

Function of Complex variable: Analytic function, C-R equations, Harmonic Functions, **Cauchy‟s integral theorem, Cauchy‟s integral formula, Derivatives of analytic functions, Taylor‟s and Laurent‟s series, Singularities, Zeroes and Poles, Residue theorem.**

UNIT V

Integral Transforms: Fourier integral, Complex Fourier transform, Inverse Transforms, Convolution Theorems, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations, wave equations and Laplace equations, Z-Transform and its application to solve difference equation.

Text Books:

1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House..

2. Jain, Iyenger Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi

3. J.N. Kapur, Mathematical Statistics, S. Chand & company Ltd.

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L	T	P
3	0	0

UFLUIME302
FLUID MECHANICS

UNIT I : Fluid and continuum, Physical properties of fluids, Rheology of fluids. Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.

UNIT II : Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential.

UNIT III: Potential Flow: source, sink, doublet and half-body. Equation of motion along a **streamline and its integration, Bernoulli‟s equation and its applications**- Pitot tube, orifice meter, venturimeter and bend meter, notches and weirs, momentum equation and its application to pipe bends. resistance to flow, Minor losses in pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks.

UNIT IV :Equation of motion f**or laminar flow through pipes, Stokes‟ law, transition from** laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control.

UNIT V : Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect. Similarity Laws: geometric, kinematics and dynamic similarity, undistorted and distorted model studies, Dimensional analysis, Buckingha**m‟s Pi theorem, important dimensionless** numbers and their significance.

BOOKS:

1. Hibbler, “Fluid Mechanicsin SI Units” 1/e Pearson Education, Noida.
2. Fox & Donald, “Introduction to Fluid Mechanics” John Wiley &Sons Pvt Ltd,
3. Cengel & Cimbala, ”Fluid Mechanics” TMH, New Delhi.
4. AK Jain “Fluid Mechanics” Khanna Publication.
5. Pnueli & Gutfinger, “Fluid Mechanics” Cambridge University Press
6. Modi & Seth “Hydraulics & Fluid Mechanics” Standard Publications.
7. Gupta, “Fluid Mechanics & Hydraulic Machines” Pearson Education, Noida

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II Year III Semester

UMATEME303
MATERIAL SCIENCE

L	T	P
3	0	0

UNIT I : Introduction: Importance of materials, historical perspective, Future aspects of engg. materials.

Crystal Structure: brief on BCC, FCC and HCP Structures, coordination number and atomic packing factors. Bravais lattices, Miller indices, crystal imperfections-point line and surface imperfections. Atomic Diffusion: Phenomenon, Ficks laws of diffusion, factors affecting diffusion.

Ferrous and non-ferrous materials: Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel, copper alloys-brasses and bronzes, Aluminium alloys. Introduction to BIS & ASTM codes and practice on material and testing.

UNIT II :**Mechanical Behaviors:** Stress-strain diagram showing ductile and brittle behaviour of materials, mechanical properties in plastic range, yield strength off set yield strength, ductility, ultimate tensile strength, toughness, Plastic deformation of single crystal by slip and twinning, Hardness Tests.

Fracture Creep Fatigue: Fracture: Type I, Type II and Type III. Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation. Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.

UNIT III :Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures. Phase Diagram I: Solid solutions Hume Rothary rule, substitution and interstitial solid solutions, intermediate phases, Gibbs phase rule.

Phase Diagram: Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions.

UNIT IV :Heat Treating of Metals: TTT curves, continuous cooling curves, annealing and its types. Normalizing, hardening, tempering, mastempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys.

Comparative study of microstructure of various Ferrous, nonferrous metals and alloys.

UNIT V

Composite materials: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's advantages and application of composites.
Ceramics: Structure types and properties and applications of ceramics. Mechanical/ Electrical behavior and processing of Ceramics.

Plastics: Various types of polymers/ plastics and its applications. Mechanical behavior and processing of plastics, Future of plastics. Introduction to Smart materials & Nano-materials and their potential applications.

Books and References:

1. Elements of Material Science & Engineering by Van Vlack, Pearson
2. Callisters Materials Science and Engineering, by William D. Callister, Jr, (Adopted by R. Balasubramaniam), Wiley India Pvt. Ltd
3. Material Science and Engineering by Smith, Hashemi and Prakash, MCGRAW HILL INDIA
4. The Science and Engineering of materials, by Askeland & Balani, Cengage Learning
5. Introduction to Materials Science for Engineers by Shackelford, Pearson
6. Material Science by Narula, MC-GRAW HILL INDIA.
7. Materials Science and Engineering - A First Course by Raghavan, PHI

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II Year III Semester

L	T	P
3	0	0

UMECHME304
MECHANICS OF SOLIDS

UNIT I : Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, princ**ipal stress and strain, maximum shear stress, Mohr"s stress circle, three dimensional states of stress & strain, equilibrium equations, generalized Hook"s law, theories of failure. Thermal** Stress.

UNIT II : **Stresses in Beams:** Pure Bending**,** normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, **Macaulay"s method, area moment method, fixed and continuous beams**

Torsion: Torsion combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes.

UNIT III :**Helical and Leaf Springs:** Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and mi**ddle quarter rules, struts with different end conditions, Euler"s theory**

for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipments and machines.

UNIT IV: Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

UNIT V: Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

Books and References:

1. Strength of Material by Rattan, MCGRAW HILL INDIA
2. Mechanics of material by Gere, Cengage Learning
3. Mechanics of Materials by Beer, Jhonston, DEwolf and Mazurek, MCGRAW HILL INDIA
4. Strength of Materials by Pytel and Singer, Harper Collins
5 . Strength of Materials by Jindal, Pearson Education.
6. Introduction to Solid Mechanics by Shames, Pearson.

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II Year III Semester

UTHERME305
THERMODYNAMICS

L	T	P
3	1	0

UNIT I :**Review of Fundamental Concepts and Definitions:** Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process,

Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign **convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Dalton‟s law, Amagat‟s** law, Property of mixture of gases.

Zeroth law of thermodynamics: Concept of Temperature and its‟ measurement, Temperature scales.

First law of thermodynamics: Thermodynamic definition of work, Displacement work and **flow work, Displacement work for various non flow processes, Joules‟** experiment, First law

analysis for closed system (non flow processes), Internal energy and enthalpy. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer.

UNIT II :**Second law of thermodynamics:** Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two

statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot **theorem and it‟s** corollaries, Thermodynamic Temperature Scale, PMM-II.

Entropy : Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNIT III :**Availability and Irreversibility**: Available and unavailable energy, Availability and **Irreversibility, Second law efficiency, Helmholtz & Gibb‟s function.**

Thermodynamic relations: Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility.

UNIT IV :**Properties of steam and Rankine cycle:** Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub-cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam-**Tables &Mollier chart, Dryness factor and it‟s measurement, processes** involving steam in closed and open systems. Simple Rankine cycle. **Air-water vapour mixture and Psychrometry**: Psychometric terms and their definitions, Psychometric chart, Different Psychometric processes and their representation on Psychometric chart.

UNIT V:**Refrigeration Cycles:** Reversed Carnot Cycle for gas and vapour. Refrigeration capacity, unit of refrigeration.Air Refrigeration cycles; Reversed Brayton Cycle and Bell Coleman Cycle. Vapour compression refrigeration cycle; simple saturated cycle and actual vapour compression refrigeration cycle. Analysis of cycles, effect of superheating, sub-cooling and change in evaporator and condenser pressure on performance of vapour compression refrigeration cycle. Refrigerants; their classification and desirable properties. Vapour absorption refrigeration system.

Books and References:

1. Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA
2. Thermodynamics for Engineers by Kroos & Potter, Cengage Learning
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
5. Basic Engineering Thermodynamics, Joel, Pearson.
6. Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
7. Engineering Thermodynamics by Dhar, Elsevier.
8. Engineering Thermodynamics by CP Arora.

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II Year III Semester

UENVIME306
ENVIRONMENT & ECOLOGY

L	T	P
3	0	0

UNIT-I: Definition, Scope& Importance, Need For Public Awarene**ss• Environmentdefinition,** Eco system - Balanced ecosystem, Human activities - Food,Shelter, Economic and social Security. Effects or human activities on environment·Agriculture, Housing,Industry, Mining and Transportation activities, Bask$ of Environmental Impact Assessment. Sustainable Development.

UNIT-II : Natural Resources Water Resources· Availability and Quality aspects.Water borne diseases, Water Induced diseases, Fluoride problem indrinking water. Mineral Resources, Forest Wealth, Material Carbon ,Nitrogen and Sulphur Cycles. Energy - Different types of energy, Electromagnetic radiation.Conventional and Non-Conventional sources - Hydro Electric, Fossil Fuel based Nuclear, Solar, Biomass and Bio.gas. Hydrogen gas and alternativefuture source of Energy.

UNIT-Ill: Environmental Pollution and their effects. Water pollution, Land pollution. Noise pollution, Public Health aspects, Air Pollution, Solid waste management, e-waste management Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Effects, Urbanization, Automobile pollution. Acid Rain Ozone Layer depletion, Animal Husbandry,

UNIT-IV : Environment-ill Protection- Role of Government, Legal aspects, initiatives by Non-, governmental organizations (NGO), Environmental Education,

Text books:

l.Environmental Studies -Benny Joseph-Tata McgrawHiU-200S

2. Environmental Studies- Dr. D.l. Manjunath, Pearson Education-2006.3.Environmental Science & Technology- M. Anaji Reddy- BS Publication ..

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II Year III Semester

L	T	P
0	0	2

UFLUIME307
FLUID MECHANICS LAB

LIST OF PRACTICAL

1. To verify the momentum equation using the experimental set-up on impact of jet.

2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.

3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.

4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.

5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number.

6. To draw a flow-net using Electrical Analogy Method.

7. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.

8. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.

9. To study the variation of friction factor, „f‟ for turbulent flow in commercial pipes.

10. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

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L	T	P
0	0	2

UMATEME308
MATERIAL SCIENCE LAB

LIST OF PRACTICAL

(A). Experiments on Material Science (at least 5 of the following):

1. Preparation of a plastic mould for small metallic specimen.
2. Preparation of specimen for micro structural examination-cutting, grinding, polishing, etching.
3. Determination of grain size for a given specimen.
4. Comparative study of microstructures of different specimens of different materials (mild steel, gray C.I., brass, copper etc.)
5. Experiments on heat treatment such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after heat treatment.
6. Material identification of, say, 50 common items kept in a box.
7. **Experiment on Faraday‟s law of electrolysis.**

(B) Experiments on Material Testing (at least 5 of the following):

1. Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2. Impact test on impact testing machine like Charpy, Izod or both.
3. Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines.
4. Spring index test on spring testing machine.
5. Fatigue test on fatigue testing machine.
6. Creep test on creep testing machine.
7. Torsion test of a rod using torsion testing machine.

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L	T	P
0	0	2

UTHERME309
THERMODYNAMICS LAB

LIST OF PRACTICAL

1. Study of Fire Tube boiler.
2. Study of Water Tube boiler .
3. Study and working of Two stroke petrol Engine.
4. Study and working of Four stroke petrol Engine.
5. Determination of Indicated H.P. of I.C. Engine by Morse Test.
6. Prepare the heat balance sheet for Diesel Engine test rig.
7. Prepare the heat balance sheet for Petrol Engine test rig.
8. Study and working of two stroke Diesel Engine.
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine.
11. Study of Pressure compounded steam turbine .
12. Study of Impulse & Reaction turbine.
13. Study of steam Engine model.
14. Study of Gas Turbine Model

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Department of Mechanical Engineering

Evaluation Scheme & Syllabus for
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(IV Semester)

(Effective from session 2025-26)

STUDY AND EVALUATION SCHEME FOR B.TECH MECHANICAL ENGINEERING

SEMESTER-IV

SUBJECT CODE	SUBJECTS NAME	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	T	P		Th	Pr	Tot	Th	Pr	Tot	
UNANOME401	Nano Science	3	0	0	3	30	-	30	70	-	70	100
UELECME402	Electrical Machines & Control	3	1	0	4	30	-	30	70	-	70	100
UAPPLME403	Applied Thermodynamics	3	0	0	3	30	-	30	70	-	70	100
UMANUME404	Manufacturing Science & Technology-I	3	0	0	3	30	-	30	70	-	70	100
UMEASME405	Measurement & Metrology	3	1	0	4	30	-	30	70	-	70	100
UUNIVME406	Universal Human Value & Professional Ethics	3	0	0	3	30	-	30	70	-	70	100
UMANUME407	Manufacturing Science and Technology-I Lab	0	0	2	1	-	25	25		25	25	50
UMEASME408	Measurement & Metrology Lab	0	0	2	1	-	25	25	-	25	25	50
UCOMPME409	Computer Aided Machine Drawing-II Lab	0	0	2	1	-	25	25	-	25	25	50
UELECME410	Electrical Machines & Controls Lab	0	0	2	1	-	25	25	-	25	25	50
	Total	18	2	8	24	180	100	280	420	100	520	800

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II Year IV Semester

UNANOME401
NANO SCIENCE

L	T	P
3	0	0

UNIT I : Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.Quantum Theory for Nano Science: Particle in a box, Potential step: Reflection and tunneling (Quantumleak). Penetration of Barrier, Potential box (Traped particle in 3D: Nanodot).Physics of Solid State Structures: Size dependence of properties, crystal structures, face centered cubicnanoparticles; Tetrehedrally bounded semiconductor structures; lattice vibrations.Energy Bands: Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps ofsemiconductors; effective masses; Fermi Surfaces. Localized Particles: Acceptors and deep taps; mobility; Excitons.

UNIT II: Quantum Nanostructure: Preparation of quantum wells, Wires and Dots, Size and Dimensionality effect,Fermi gas; Potential wells; Partial confinement; Single electron Tunneling, Infrared detectors; Quantumdot laser superconductivity.Properties of Individual Nano Particles: Metal nano clusters; Magic numbers; Theoretical modeling ofnanoparticles; geometric structure; electronic structure; Reactivity, Fluctuations, Magnetic clusters; Bulkto nanostructure, semiconducting nanoparticles, Optical Properties, Photofragmentation, ColumbicExplosion. Rare Gas & Molecular clusters; Inert gas clusters; Superfluid clusters; Molecular clusters.

UNIT III: Growth Techniques of Nano materials: Litho and Nonlitho grapahic techniques, RF Plasma, Chemicalmethods, Thermolysis, Pulsed laser method, Self-assembly, E-beam evaporation, Chemical VapourDeposition, Pulsed Laser Deposition.

UNIT IV: Methods of Measuring Properties: Structure: X-ray Diffraction Technique, Particle size determination,surface structure. Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM),Field Ion Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy(TEM).Spectroscopy: Infra red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical andVibrational Spectroscopy, Luminescence.

UNIT V: Carbon Nano Materials: Bucky Ball and Carbon Nano- Tubes: Nano structures of carbon (fullerene),Fabrication, Structure. Electrical, Mechanical and Vibrational properties and applications. NanoDiamond, Boron Nitride Nano-tubes, Single Electron Transistors, Molecular Machine, Nano-Biometrics, Nano Robots.

Text/Reference Books:

1. **CP Poole Jr, FJ Owens, "Introduction to Nanotechnology".**

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II Year IV Semester

UELECME402
ELECTRICAL MACHINES & CONTROLS

L	T	P
3	1	0

UNIT I : **Single phase Transformer:** Efficiency Voltage regulation, O.C.& S.C. Tests. **Three Phase Transformer:** Three phase transformer connections, 3-phase to 2-phase or 6-phase connections and their applications. **Auto Transformer:** Volt- Amp relations, efficiency, advantages & disadvantages, applications. **D.C. Motors:** Concept of starting, speed control, losses and efficiency.

UNIT II : **Three phase Induction Motor:** Construction, equivalent circuit, torque equation and torque-slip characteristics, speed control. **Alternator:** Construction, e.m.f. equation, Voltage regulation and its determination by synchronous impedance method. **Synchronous Motor:** Starting, effect of excitation on line current (V-curves), synchronous condenser. **Servo Motor:** Two phase A.C. servo motor & its application.

UNIT III : **Modeling of Mechanical System:** linear mechanical elements, force-voltage and force current analogy, electrical analog of simple mechanical systems; concept of transfer function & its determination for simple systems. **Control System:** Open loop & closed loop controls, servo mechanisms; concept of various types of system. **Signals:** Unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics**.**

UNIT IV : **Time Response Analysis:** Time response of a standard second order system and response specifications, steady state errors and error constants. **Stability:** Concept and types of stability, Routh Hurwitz Criterion and its application for determination of stability, limitations; Polar plot, Nyquist stability Criterion and assessment of stability.

UNIT V : **Root Locus Techniques:** Concept of root locus, construction of root loci. **Frequency Response Analysis:** Correlation between time and frequency responses of a second order system; Bode plot, gain margin and phase margin and their determination from Bode and Polar plots. **Process control:** Introduction to P, PI and PID controllers their characteristics, representation and applications.

Text and Reference Books:

1. IJ Nagrath & D. P. Kotha**ri, "Electrical machines" Tata McGraw Hill.**
2. BR Gupta & Vandana Singhal, "Fundamentals of Electrical Machines", New Age International.
3. K. Ogata, "Modern Control Engineering" Prentice Hall of India.
4. BC Kuo, "Automatic Control systems." Wiley India Ltd.

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L	T	P
3	0	0

UAPPLME403
APPLIED THERMODYNAMICS

UNIT I

Gas power cycle: Air Standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, Comparison of Otto, Diesel

and dual cycles. **I.C. Engine**: Testing of two stroke and four stroke SI and CI engines for **performance Related numerical problems, heat balance, Motoring Method, Willian‟s line**
method, swinging field dynamometer, Morse test.

UNIT II

Vapour Power cycles: Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration. **Fuels and Combustion:** Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

UNIT III

Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. **Condenser:** Classification of condenser, air leakage, condenser performance parameters.

UNIT IV

Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, Choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow.

Steam Turbines : Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles.

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

Books and References:

1. Basic and Applied Thermodynamics by P.K. Nag, MCGRAW HILL INDIA
2. Applied thermodynamics by Onkar Singh, New Age International
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education
4. Applied Thermodynamics by Venkanna And Swati, PHI
5. Theory of Stream Turbine by WJ Kearto

Department of Mechanical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year IV Semester

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UMANUME404
MANUFACTURING SCIENCE & TECHNOLOGY-I

UNIT I

Introduction: Importance of manufacturing. Economic & technological considerations in manufacturing. Classification of manufacturing processes. Materials & manufacturing processes for common items. **Metal Forming Processes**: Elastic & plastic deformation, yield criteria **(Mises" and Tresca"s). Hot working versus cold working. Analysis (equilibrium equation** method) of Forging process for load estimation with sliding friction, sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging.

UNIT II

Metal Forming Processes (continued): Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application. Condition for Rolling force and power in rolling. Rolling mills & rolled-sections. Design, lubrication and defects in metal forming processes.

UNIT III

Sheet Metal working: Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism, Blanking vs. Piercing. Compound vs. Progressive die. Flat-face vs Inclined-face punch and Load (capacity) needed. Analysis of forming process like cup/deep drawing. Bending & spring-back.

UNIT IV

Casting (Foundry): Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand, sand testing. Elements of mould and design considerations, Gating, Riser, Runnes, Core. Solidification of casting, Sand casting, defects & remedies and inspection. Cupola furnace. Die Casting, Centrifugal casting, Investment casting, Continuous casting, CO2 casting and Stir casting etc.

UNIT V

Unconventional Metal forming processes: Unconventional metal forming or High Energy Rate Forming (HERF) processes such as explosive forming, electromagnetic, electro-hydraulic forming. **Powder Metallurgy**: Introduction to Powder metallurgy manufacturing process. Application and, advantages. **Jigs & Fixtures**: Locating & Clamping devices & principles. Jigs and Fixtures and its applications. **Manufacturing of Plastic components**: Review of plastics, and its past, present & future uses. Injection moulding. Extrusion of plastic section. Welding of plastics. Future of plastic & its applications. Resins & Adhesives.

Books and References :

1. Manufacturing Science by Ghosh and Mallik
2. Production Engg. Science by PC Pandey
3. Manufacturing Engineering & Technology by Kalpakjian, Pearson
4. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA
5. Manufacturing Processes by Lindberg, Pearson.
6. Manufacturing Processes foe Engineering materials by Kalpakjian, Pearson.

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UMEASME405
MEASUREMENT AND METROLOGY

UNIT I

Mechanical Measurements: Introduction to measurement and measuring instruments. General concept–Generalized measurement system and its elements-Unit sand standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic, Source of error, statistical analysis of error and random errors-correction, calibration. Dimensional and geometric tolerance

Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

UNIT II

Time Related Measurement: Stroboscope, frequency measurement by direct comparison. **M**easurement of displacement **Measurement of Pressure:** Gravitational, directing acting, elastic & indirect type pressure transducers. Measurement of very low pressures (high vacuum).

Strain Measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration.

UNIT III

Flow Measurement: Hot Wire Anemometry, Laser Doppler Velocity Meter, Rotameter

Temperature Measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers. **Measurements of Force, Torque:** Different types of load cells, elastic transducers, pneumatic & hydraulic systems. Seismic instruments **Measurements of Acceleration, and Vibration**: Accelerometers vibration pickups and decibel meters, vibrometers.

UNIT IV

Coordinate measuring machine (CMM): Need, constructional features and types,

Metrology and Inspection: Standards of linear measurement, line and end standards. Interchange ability and standardization. Linear and angular measurements devices and systems

Comparators: Sigma, Johansson‟s Microkrator. Limit gauges classification, Taylor‟s Principle of Gauge Design

UNIT-V

Limits, Fits &Tolerance and Surface roughness: Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness. Measurement of geometric forms like straightness, flatness, roundness. Tool makers microscope, profile projector, autocollimator. **Interferometry**: principle and use of interferometry, optical flat. Measurement of screw threads and gears. Surface texture: quantitative evaluation of surface roughness and its measurement.

Books and References:

1. Experimental Methods for Engineers by Holman, MCGRAW HILL INDIA
2. Mechanical Measurements by Beckwith, Pearson
3. Principles of Measurement Systems by Bentley, Pearson
4. Metrology of Measurements by Bewoor and Kulkarni, MCGRAW HILL INDIA
5. Measurement Systems, Application Design by Doeblein, MCGRAW HILL INDIA
6. **Hume KJ, “Engineering Metrology”, MacDonald and Co**
7. **Jain, RK, “Engineering Metrology” Khanna Publishers**
8. **Jain, R.K., “Mechanical Measurement” Khanna Publishers**

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UUNIVME406
UNIVERSAL HUMAN VALUE & PROFF. ETHICS

UNIT 1:

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education 1. Understanding the need, basic guidelines, content and process for Value Education

2. Self Exploration–what is it? - **its content and process; „Natural Acceptance‟ and Experiential** Validation- as the mechanism for self exploration

3. Continuous Happiness and Prosperity- A look at basic Human Aspirations

4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority

5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

UNIT 2:

Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-**existence of the sentient „I‟ and the material „Body‟**

8. Understanding the needs of Self („I‟) and „Body‟ - Sukh and Suvidha

9. Understanding the Body as an instrument of **„I‟ (I being the doer, seer and enjoyer)**

10.Understanding the characteristics and activities of „I‟ and harmony in „I‟

11.Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail

12.Programs to ensure Sanyam and Swasthya - Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 3:

Understanding Harmony in the Family and Society- Harmony in HumanHuman Relationship

13.Understanding Harmony in the family – the basic unit of human interaction

14.Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship

15.Understanding the meaning of Vishwas; Difference between intention and competence

16.Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship

17.Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals

18.Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family! - Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 4:

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence 19.Understanding the harmony in the Nature

20.Interconnectedness and mutual fulfillment among the four orders of naturerecyclability and self-regulation in nature

21.Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space

22.Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 5:

Implications of the above Holistic Understanding of Harmony on Professional Ethics

23.Natural acceptance of human values

24.Definitiveness of Ethical Human Conduct

25.Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

26.Competence in professional ethics:

a) Ability to utilize the professional competence for augmenting universal human order

b) Ability to identify the scope and characteristics of people-friendly and ecofriendly production systems,

c) Ability to identify and develop appropriate technologies and management patterns for above production systems.

27. Case studies of typical holistic technologies, management models and production systems

28.Strategy for transition from the present state to Universal Human Order:

a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers

b) At the level of society: as mutually enriching institutions and organizations

Books and References:

1.R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

2. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow, Reprinted 2008.

3. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.

4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986,

5.A.N. Tripathy, 2003, Human Values, New Age International Publishers.

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UMANUME407
MANUFACTURING SCIENCE & TECHNOLOGY-I LAB

List of Practical:

1. Design of pattern for a desired casting (containing hole).
2. Pattern making with proper allowance.
3. Making a mould (with core) and casting.
4. Sand testing methods (at least one, such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging - hand forging processes
7 Jigs & Fixture experiment
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.

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UMEASME408
MEASUREMENT AND METROLOGY LAB

List of Practical:

1. Study the working of simple measuring instruments- Vernier calipers, micrometer, and tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire methods.
3. Study and Measurement of angle using sine bar & slip gauges.
4. Study & angular measurement using level protector.
5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Use of dial indicator and V Block to check the circularity and plot the polar Graph.
9. Study and understanding of limits, fits & tolerances.
10. To study the displacement using LVDT
11. Study of temperature measuring equipments.
12. Experiment on measurement of flow.

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UCOMPME 409
COMPUTER AIDED MACHINE DRAWING-II LAB

Introduction: Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).

Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviation used.

Part Modeling: Introduction to part modeling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model ***(Minimum 24 machine components need to be developed).***

Part Modeling & Assemblies of: Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

Books and References:

1. Textbook of Machine Drawing, K C John, PHI
2. Machine Drawing by K.R. Gopalakrishna, Subhas Stores.
3. A Textbook of Machine Drawing by PS Gill from S.K. Kataria & Sons
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age publications
5. Engineering Graphics with AutoCAD, Bethune, PHI
6. Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill
7. Fundamentals of Machine Drawing, Dr Sadhu Singh & P L Shah, Prantice Hall India
8. Autodesk Inventor by Examples, Sam Tikoo, Wiley.

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UELECME410
ELECTRICAL MACHINES & CONTROLS LAB

List of Practical

A. Electrical Machines

1. To obtain speed-torque characteristics and efficiency of a dc shunt motor by direct loading.
2. To obtain efficiency of a dc shunt machine by no load test.
3. To obtain speed control of dc shunt motor using (a) armature voltage control (b) field control.
4. To determine polarity and voltage ratio of single phase and three phase transformers.
5. To obtain efficiency and voltage regulation by performing O.C. and S.C. tests on a single phase transformer at full load and 0.8 p.f. loading.
6. To obtain 3-phase to 2-phase conversion using Scott connection.

B. Control Systems:

1. To determine transient response of a second order system for step input for various values of **constant „K" using linear simulator unit and compare theoretical and practical results.**
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To determine speed – torque characteristics of an a.c. 2-phase servo motor.
4. To study and calibrate temperature using Resistance Temperature Detector (RTD)