COURSES & EXAMINATION SCHEME

For

B. Tech. (Common to B. Tech. Mechanical Engineering/Production Engg./Industrial & Production Engineering)

YEAR II, SEMESTER –III

(Effective from the session: 2010-2011)

Uttrakhand Technical University,Dehradun

B. Tech.
(Mechanical Engg./Production Engg./Industrial & Production Engg.)
YEAR II, SEMESTER –III

Subject Code	Subject	Contact Hrs. (L-T-P)	Credit
A) THEORY:			
TMA-301	Mathematics-III	3-1-0	4
THU-301	Engineering Economics	2-1-0	3
TME-301	Material Science	3-1-0	4
TME 302	Engineering Thermodynamics	2-1-0	3
TCE 301**	Fluid Mechanics	3-1-0	4
TME 303##	Solid Mechanics	3-1-0	4
B) PRACTICAL:			
PME 351	Material Science Lab	0-0-2	1
PME 352	Machine Drawing	1-0-3	3
PCE 351	Fluid Mechanics Lab	0-0-3	2
GP-301	General Proficiency (NSS/NCC/Sports/Cultural)	-	-
		TOTAL	**28**

**Common to Civil Engineering
##Common to Civil, Chemical & Bio-chemical Engineering

COURSES AND EVALUATION SCHEME

B. Tech. Second Year

(Common to B. Tech. Mechanical Engineering/Production Engg./Industrial & Production Engineering)

YEAR II, SEMESTER –III

Sl. No.	Course code	Subject	PERIODS			Evaluation scheme				Subject Total	Credits
						SESSIONAL EXAM			ESE		
A) THEORY											
			L	T	P	CT	TA	Total			
1	TMA-301	Mathematics-III	3	1	0	30	20	50	100	150	4
2	THU-301	Engineering Economics	2	1	0	15	10	25	50	75	3
3	TME-301	Material Science	3	1	0	30	20	50	100	150	4
4	TME 302	Engineering Thermodynamics	2	1	0	15	10	25	50	75	3
5	TCE 301**	Fluid Mechanics	3	1	0	30	20	50	100	150	4
6	TME 303##	Solid Mechanics	3	1	0	30	20	50	100	150	4
B) PRACTICAL / TRAINING / PROJECT											
7	PME 351	Material Science Lab	0	0	2	-	25	25	25	50	1
8	PME 352	Machine Drawing	1	0	3	-	50	50	50	100	3
9	PCE 351	Fluid Mechanics Lab	0	0	3	-	25	25	25	50	2
10	GP-301	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	-	50	-	50	-
		TOTAL	17	6	8	-	-	-	-	**1000**	**28**

**Common to Civil Engineering

##Common to Civil, Chemical & Bio-chemical Engineering

TMA-301 MATHEMATICS –III

L	T	P
3	1	0

Unit – I: Function of Complex variable

Analytic function, C-R equations, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic function, Taylor's and Laurent's series, singularities, Residue theorem, Evaluation of real integrals of the type $\int_0^{2\pi} f(cos\theta, sin\theta)d\theta$ and $\int_{-\pi}^{+\pi} f(x)dx$ **10**

Unit – II: Statistical Techniques - I

Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non – linear and multiple regression analysis, Probability theory. **08**

Unit – III: Statistical Techniques - II

Binomial, Poisson and Normal distributions, Sampling theory (small and large), Tests of significations: Chi-square test, t-test, Analysis of variance (one way), Application to engineering, medicine, agriculture etc.

Time series and forecasting (moving and semi-averages), Statistical quality control methods, Control charts, X, R, p, np, and c charts. **08**

Unit – IV: Numerical Techniques – I

Zeroes of transcendental and polynomial equation using Bisection method, Regula-falsi method and Newton-Raphson method, Rate of convergence of above methods.

Interpolation: Finite differences, difference tables, Newton's forward and backward interpolation , Lagrange's and Newton's divided difference formula for unequal intervals. **08**

Unit – V: Numerical Techniques –II

Solution of system of linear equations, Gauss-Seidal method, Crout method. Numerical differentiation, Numerical integration , Trapezoidal , Simpson's one third and three-eight rules, Solution of ordinary differential (first order, second order and simultaneous) equations by Euler's, Picard's and forth-order Runge- Kutta methods. **08**

Reference Books :-

1. T. Veerajan & T. Ramchandran, Theory & Problems in Numerical Methods, TMH, New Delhi, 2004.
2. Devore, Probability and Statistics, Thomson(Cengage) Learning, 2007.
3. Walpole, Myers, Myers & Ye, Probability and Statistics for Engineers & Scientists, Pearson Education, 2003.
4. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.

THU-301 ENGINEERING ECONOMICS

L	T	P
2	1	0

Unit-I

Time value of money : Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation, Calculation of time –value equivalences.

Present worth comparisons, Comparisons of assets with equal, unequal and infinite lives, comparison of deferred investments, Future worth comparison, payback period comparison. (8)

Unit-II

Use and situations for equivalent annual worth comparison, Comparison of assets of equal and unequal life. Rate of return, Internal rate of return, comparison of IIR with other methods, IRR misconceptions. (8)

Unit-III

Analysis of public Projects: Benefit/ Cost analysis, quantification of project, cost and benefits, benefit/ cost applications, Cost –effectiveness analysis. (9)

Unit-IV

Depreciation, computing depreciation charges, after tax economic comparison, Break-even analysis; linear and non-linear models.

Product and Process Costing, Standard Costing, cost estimation, Relevant Cost for decision making, Cost control and Cost reduction techniques. (8)

Reference Books :

1. Horn green, C.T., Cost Accounting, Prentice Hall of India
2. Riggs, J.L., Dedworth, Bedworth, D.B, Randhawa, S.U. Engineering Economics, McGraw Hill International Edition, 1996

TME- 301 MATERIAL SCIENCE

L	T	P
3	1	0

Unit-I

Introduction : Historical perspective, importance of materials. Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bondings. 4

Crystallography and Imperfections : Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. X-ray crystallography techniques. Imperfections, Defects & Dislocations in solids. 3

Unit-II

Mechanical properties and Testing : Stress strain diagram, Ductile & brittle material, Stress vs. strength. Toughness, Hardness, Fracture, Fatigue and Creep. Tastings such as Strength tastings, Hardness testing, Impact tastings, Fatigue testing Creep testing, Non-destructive testing (NDT) 4

Micro structural Exam : Microscope principle and methods. Preparation of samples and Microstructure exam and grain size determination. Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass. 2

Phase Diagram and Equilibrium Diagram : Uniary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-carbon equilibrium diagram. 4

Unit-III

Ferrous materials : Brief introduction of iron and steel making furnaces. Various types of carbon steels, alloy steels and cast irons, its properties and uses. 3

Heat Treatment : Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams. 2

Non-Ferrous metals and alloys : Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various type Brass, Bronze, bearing materials, its properties and uses. Aluminum alloys such as Duralumin. Other advanced materials/alloys. 3

Unit-IV

Magnetic properties : Concept of magnetism - Dia, para, Ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages. 2

Electric properties : Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors. P-n junction and transistors. Basic devices and its application. Diffusion of Solid. 3

Super conductivity and its applications. Messier effect. Type I & II superconductors. High Tc superconductors. 2

Unit-V

Ceramics : Structure types and properties and applications of ceramics. Mechanical/Electrical behavior and processing of Ceramics. 2

Plastics : Various types of polymers/plastics and its applications. Mechanical behavior and processing of plastics. Future of plastics. 2

Other materials : Brief description of other material such as optical and thermal materials concrete, Composite Materials and its uses. Brief introduction to Smart materials & Nano-materials and their potential applications 3

Performance of materials in service: Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control. 2

References :

1. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesley Publication.
2. Van Vlash - Elements of Material Science & Engineering John Wiley & Sons.
3. V. Raghvan - Material Science, Prentice Hall.

TME 302 ENGINEERING THERMODYNAMICS

L	T	P
2	1	0

UNIT I: INTRODUCTION

Review of fundamental concepts and definitions. Review of first and second law of thermodynamics, entropy, properties of substances. (5)

UNIT II: AVAILABLE ENERGY, EXERGY AND IRREVERSIBILITY

Available energy, available energy referred to a cycle, quality of energy, maximum work in a reversible process, reversible work by an open system exchanging heat only with surroundings, useful work, dead state, availability, availability in a chemical reaction, irreversibility and Gouy-Stodala Theorem, availability or exergy balance, second law efficiency, comments on exergy, Helmholtz and Gibb's function. (7)

UNIT III: THERMODYNAMIC RELATIONS, EQUILIBRIUM AND THIRD LAW

Mathematical conditions for exact differential, Maxwell's equation, Tds equation, difference in heat capacities, ratio of heat capacities, energy equation, Joule-Kelvin effect, Clausius-Clapeyron equation, evaluation of thermodynamic properties from an equation of state, general thermodynamic considerations on an equation of state, mixtures of variable composition, conditions of equilibrium of a heterogeneous system, Gibbs phase rule, types of equilibrium, local equilibrium conditions, conditions of stability, Joule-Thompson coefficient and Inversion curve, coefficient of volume expansion, adiabatic and isothermal compressibility. (8)

UNIT IV: GAS POWER CYCLES AND GAS COMPRESSORS

Gas power cycles

Carnot cycle, Stirling cycle, Ericsson cycle, Air standard cycles, Otto cycle, Diesel cycle, Limited pressure cycle or Dual cycle, comparison of Otto, Diesel and Dual cycles, Brayton cycle, Aircraft propulsion, Brayton-Rankine combined cycle. (4)

Gas compressors

Compression processes, work of compression, single stage reciprocating air compressor, volumetric efficiency, multi stage compression, air motors, rotary compressors, blowers and fans. (3)

Reference Books:

1. Engineering thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
2. Fundamentals of thermodynamics by Sonntag, Wiley India Pvt. Ltd.
3. Fundamentals of Classical Thermodynamics by Van Wylen, John Wiley and Sons.
4. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man Ltd.

TCE-301 **FLUID MECHANICS**

L	T	P
3	1	0

Unit-I: Introduction :
Fluid and continuum, Physical properties of fluids, Rheology of fluids.

Kinematics of Fluid flow : 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, source, sink, doublet and half-body.

Unit-II: Fluid Statics:
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.

Dynamics of Fluid Flow: Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturi meter and bend meter, Hot-wire anemometer and LDA, notches and weirs, momentum equation and its application to pipe bends.

Unit-III: Dimensional Analysis and Hydraulic Similitude:
Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies.

Unit-IV: Laminar and Turbulent Flow:
Equation of motion for 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, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and networks.

Unit-V: Boundary Layer Analysis:
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, Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect.

Reference Books :

1. S Narasimhan: First Course in Fluid Mechanics, University Press
2. Som, S.K. & Biswas G.: Introduction of fluid mechanics & Fluid Machines, TMH, 2000, 2nd edition.
3. M M Das: Fluid Mechanics & Turbomachines, Oxford University Press
4. Hunter Rouse, "Elementary Mechanics of Fluids", John Wiley & Sons. Omc. 1946
5. Vijay Gupta and S.K.Gupta, " Fluid Mechanics and its Applications", Wiley Eastern Ltd, 1984.

TME- 303 SOLID MECHANICS

L	T	P
3	1	0

Unit-I

Introduction. Stress and strain: stress at point, Cauchy stress tensor, equilibrium equations, analysis of deformation and definition of strain components, compatibility relations, 8
principal stresses and strains, stress and strain invariants, Mohr's circle representation. 3

Unit-II

Constitutive relations: true and engineering stress-strain curves, Material properties for isotropic materials and their relations. Theories of failures for isotropic materials. 7

Unit-III

Shear Force and Bending Moment diagrams. Axially loaded members. Torsion of circular shafts Stresses due to bending: pure bending theory, combined stresses. 7

Unit-IV

Deflections due to bending: moment-curvature relation, load-defection differential equation, area moment method, and superposition theorem. Stresses and deflections due to transverse shears. 8

Unit-V

Torsion of circular shaft. Energy methods: Strain energy due to axial, torsion, bending and transverse shear. Castigliano's theorem, reciprocity theorem etc. 7

Reference Books:

1. S. C. Crandall, N. C. Dahl, and T. J. Lardner, *An Introduction to the Mechanics of Solids*, 2e, McGraw Hill,1978.
2. E. P. Popov, *Engineering Mechanics of Solids*, Prentice Hall, 1990
3. Mechanics of Materials by Bear Jhonson

PME- 351 MATERIAL SCIENCE LAB

L	T	P
0	0	2

Material Science Lab Experiments:

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray cast iron, brass, copper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Material identification of, say, 50 common items kept in a box.
7. Faradays law of electrolysis experiment.
8. Study of corrosion and its effects.
9. Study of microstructure of welded component and HAZ. Macro and Micro Examination.
10. Suitable experiment on Magnetic/ Electrical/ Electronic materials.

PME – 352 MACHINE DRAWING LAB

L	T	P
1	0	3

Assembly and Part Drawings of simple assemblies and subassemblies of machine parts viz., couplings, clutches, bearings, gear assemblies, I.C. Engine components, valves, machine tools, etc.; IS/ISO codes;
Limits, tolerances and Fits, Surface finish; Symbols for weldments, process flow, electrical and instrumentation units.
Introduction to solid modellers. A drawing project on reverse engineering.

Reference Books:

1. N.D. Bhatt, *Machine Drawing*, Charotar Book Stall, Anand, 1996.
2. N. Sidheswar, P. Kanniah and V.V.S. Sastry, *Machine Drawing*, Tata McGraw Hill, 1983.
3. *SP 46: 1988 Engineering Drawing Practice for School & Colleges*. Bureau of Indian Standards

PCE-351 FLUID MECHANICS LAB

L	T	P
0	0	2

1. To verify the momentum equation using the experimental set-up on diffusion of submerged air 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, venturimeter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
5. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
6. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
7. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

COURSES & EXAMINATION SCHEME

For

B. Tech. (Common to B. Tech. Mechanical Engineering/Production Engg./Industrial & Production Engineering)

YEAR II, SEMESTER –IV

(Effective from the session: 2010-2011)

Uttrakhand Technical University, Dehradun

B. Tech. (Mechanical Engineering/Production Engg./Industrial & Production Engineering)
YEAR II, SEMESTER –IV

Subject Code	Subject	Contact Hrs	Credit
A) THEORY:			
TME-401	Kinematics of Machines	3-1-0	4
TME-402	Manufacturing Science-I	3-1-0	4
TME-403	Mechanical Measurement and Control	3-1-0	4
TME-404	Applied Thermodynamics	3-1-0	4
TME-405	Industrial Engineering	2-1-0	3
TEE-405	Control System	2-1-0	3
B) PRACTICAL:			
PME-451	Manufacturing Science Lab-I	0 0 3	2
PME-452	Measurement & Metrology Lab	0 0 3	2
PME-453	Thermodynamics lab	0 0 2	1
PEE- 454	Control System Lab	0 0 2	1
GP-401	General Proficiency (NSS/NCC/Sports/Cultural)	-	-
		Total	**28**

COURSES AND EVALUATION SCHEME
(Common to B. Tech. Mechanical Engineering/Production Engg./Industrial & Production Engineering)
(Effective from Session 2010-11)
YEAR II, SEMESTER –IV

Sl. No.	Course code	Subject	PERIODS			Evaluation Scheme				Subject Total	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	Total			
A) THEORY											
1	TME-401	Kinematics of Machines	3	1	0	30	20	50	100	150	4
2	TME-402	Manufacturing Science-I	3	1	0	30	20	50	100	150	4
3	TME-403	Mechanical Measurement	3	1	0	30	20	50	100	150	4
4	TME-404	Applied Thermodynamics	3	1	0	30	20	50	100	150	4
5	TME-405	Industrial Engineering	2	1	0	15	10	25	50	75	3
6	TEE-405	Control System	2	1	0	15	10	25	50	75	3
B) PRACTICAL / TRAINING / PROJECT											
7	PME-451	Manufacturing Science Lab-I	0	0	3	-	25	25	25	50	2
8	PME-452	Measurement & Metrology Lab	0	0	3	-	25	25	25	50	2
9	PME-453	Thermodynamics lab	0	0	2	-	25	25	25	50	1
10	PEE- 454	Control System Lab	0	0	2	-	25	25	25	50	1
11	GP-401	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	-	50	-	50	-
		TOTAL	**16**	**06**	**10**	-	-	-	-	**1000**	**28**

TME 401 KINEMATICS OF MACHINES

L	T	P
3	1	0

UNIT I:

Introduction: Links-types, Kinematics pairs-classification, Constraints-types, Degree of Freedom, Grubler's equation, linkage mechanisms, inversions of four bar linkage, slider crank chain and double slider crank chain. **(6)**

Velocity in Mechanisms: Velocity of point in mechanism, relative velocity method instantaneous point in mechanism, Kennedy's theorem, instantaneous center method **(3)**

UNIT II:

Acceleration in Mechanisms: Acceleration diagram, Coriolis component of acceleration, Klein's construction for Slider Crank and Four Bar mechanism, Analytic method for slider crank mechanism. **(4)**

Mechanisms with Lower Pairs: Pantograph, Exact straight line motion mechanisms-Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms – Grass-Hopper, Watt and Tchebicheff mechanisms. **(5)**

UNIT III:

Kinematics Synthesis of Planar Linkages: Movability of four bar linkages, Grashoff's law, Graphical methods of synthesis – Two and Three position synthesis of four bar and slider crank mechanisms, Analytical method-Freudenstein's equation for function generation (three position**)** **(7)**

UNIT IV:

CAMS: Cams and Followers - Classification & terminology, Cam profile by graphical methods for uniform velocity, simple harmonic motion and parabolic motion of followers. **(7)**

UNIT V:

Gears: Classification & terminology, law of gearing, tooth forms, interference, under cutting, minimum number of teeth on gear and pinion to avoid interference, simple, compound and planetary gear trains. **(8)**

Books and References:

1. Theory of machines and mechanisms-Ghosh & Mallik, East-West Press
4. Theory of machines and mechanisms- S. S. Ratan, Tata Mc-Graw Hill
5. Theory of machines and mechanisms- Rao & Dukkipati,

TME- 402 MANUFACTURING SCIENCE-I

L	T	P
3	1	0

Unit-I

Introduction : Importance of manufacturing. Economic & technological considerations in manufacturing. Classification of manufacturing processes. Materials & manufacturing processes for common items. (2)

Metal Forming Processes : Elastic & plastic deformation, yield criteria. Hot working vs cold working. (2)

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. (5)

Unit-II

Metal Forming Processes (continued): Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application. (3)

Condition for Rolling force and power in rolling. Rolling mills & rolled-sections. (2)

Design, lubrication and defects in metal forming processes. (2)

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. (4)

Analysis of forming process like cup/deep drawing. Bending & spring-back. (3)

Unit-IV

Unconventional Metal forming processes: Unconventional metal forming processes such as explosive forming, electromagnetic, electro-hydraulic forming. (2)

Powder Metallurgy: Powder metallurgy manufacturing process. The need, process, advantage and applications. (2)

Jigs & Fixtures :

Locating & Clamping devices & principles. Jigs and Fixtures and its applications. (2)

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. (2)

Unit-V

Casting (Foundry): Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand. Elements of mould and design considerations, Gating, Riser, Runnes, Core. Solidification of casting,. Sand casting, defects & remedies and inspection. Cupola furnace. (7)

Die Casting, Centrifugal casting. Investment casting, CO_2 casting and Stir casting etc. (3)

Reference Books:

1. Manufacturing Science by Ghosh and Mallik, John Wiley and Sons

TME -403 MECHANICAL MEASUREMENT

L	T	P
3	1	0

Unit-I: Mechanical Measurements:
Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors. 4
Sensors and Transducers: Types of sensors, types of transducers and their characteristics. 2
Signal transmission and processing: Devices and systems. Signal Display & Recording Devices 3
Unit-II: Time related measurements: Counters, stroboscope, frequency measurement by direct comparison. Measurement of displacement 2
Measurement of pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures. 1
Strain measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration. 2
Measurements of force and torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. 2
Temperature measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers. 2
Vibration: Seismic instruments, vibration pick-ups and decibel meters, vibrometers accelerometers. 2

Unit-III: Metrology and Inspection: Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardization. 2
Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Mikrokator. 2
Limit gauges classification, Taylor's Principle of Gauge Design. 1

Unit-IV:
Measurement of geometric forms like straightness, flatness, roundness. Tool makers microscope, profile project 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. 6

Unit-V:

Concept of Automatic Controls- Open loop & closed loop systems. Servomechanism. Block diagrams 4

Brief introduction to Pneumatic, Hydraulic and Electric controllers. 2

Reference Books:

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, 1990.
3. Raven, Automatic Cotrol Theory, Mc-Graw Hill Publisher
10.Nagrath and Gopal, Control System Engineering, New Age Publications

TME-404 APPLIED THERMODYNAMICS

L	T	P
3	1	0

Unit-I

Review of Properties of steam and thermodynamics cycles: Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of thermodynamic processes on P-T & P-V diagrams, T-S and H-S diagrams, Use of property diagram, Steam-Tables & Mollier charts, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle. (6)

Unit-II

Boilers: Steam generators-classifications. Working of fire-tube and water-tube boilers, boiler mountings & accessories, Draught & its calculations, air pre-heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. (6)

Condenser: Classification of condenser, Air leakage, Condenser performance parameters (2)

Unit-III

Steam Engines: Rankine and modified Rankine cycles, Working of stream engine, Classification of steam engines, Indicator diagram, Saturation curve, Missing quantity, Heat balance. (3)

Steam& Gas Nozzles: Flow through nozzle, Variation of velocity, Area and specific volume, Choked flow, Throat area, Nozzle efficiency, Off design operation of nozzle, Effect of friction on nozzle, Super saturated flow. (4)

Unit-IV

Vapour Power cycles: Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration. (4)

Steam Turbines : Classification of steam turbine, Impulse and reaction turbines, Staging, Stage and overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple & compound multistage impulse & reaction turbines & related calculations work done efficiencies of reaction, Impulse reaction Turbines, state point locus, Comparison with steam engines, Losses in steam turbines, Governing of turbines. (6)

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. (5)

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine. (3)

Books:

1. Applied thermodynamics by Onkar Singh, New Age International (P) Publishers Ltd.
2. Basic and Applied Thermodynamics by P.K. Nag, Tata Mc Graw Hill Pub.
3. Thermal Engg. By P.L. Ballaney, Khanna Publisher

4. Theory of Stream Turbine by W.J. Kearton
7. Gas Turbine, by V. Ganeshan, Tata Mc Graw Hill Publishers.
8. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man

TME - 405 INDUSTRIAL ENGINEERING

L	T	P
2	1	0

Unit-I

Productivity: Introduction, definition, measurement, productivity index, ways to improve productivity, Types of Production System. 2

Work study : Meaning and benefits of work study, time & motion study. Micromotion study P.M.T.S. man machine Diagram flow chart. Motion economy, Method study, work measurement, work sampling, standard time. 4

Unit-II

Plant layout and materials Handling : Plant location, type of layout, principles of facility layout principles of material handling, Material Handling eqpts. 3

Replacement Analysis : Depreciation causes, obsolescence, service life of assets, Replacement of items. 2

Maintenance Management : Maintenance Planning & Control, Maintenance Strategy 2

Unit-III

Inventory Control : Inventory, function, cost, deterministic models, Introduction to MRP, supply chain Management 4

Quality Control : Introduction, process control, SQC control Charts, Single double & sequential sampling, Introduction to TQM & bench marking. 4

Unit-IV

Industrial Ownership: Proprietorship, partnership, Joint stock & co-operative stores. 2

Manpower Planning: Resources, Human relationship. 2

Organization: Principles of organization, Development of Organizational charts like line, staff, line and staff & Functional types. 2

Job Evaluation & Merit Rating: Job analysis, Job description job simplification and job evaluation methods & description, merit rating, wage incentive plans. 3

Reference Books:

1. Principles of management. An analysis of management functions-H. Koontz & C.O. Donnel. Tata Mc-Graw-Hall Co.
2. Manufacturing Management-J Moore Prentice Hall Englewood Cliffs: New Jersey.
3. Modern production operations Management-Buffa, E.S. Wiley Eastern.
4. Industrial Engineering & Management O.P. Khanna.
5. Industrial Engineering by Ravi Shanker.
6. Industrial Engineering by Mahajan.

TEE: 405 **CONTROL SYSTEM**

L	T	P
2	1	0

Unit-I

Introduction: Laplace Transform and its applications, Transfer function and its determination, Modeling of mechanical system: Linear mechanical elements, force-voltage and force current analogy, Electrical analog of simple mechanical system, **6**

Unit-II

Time Response analysis: Standard test signals, time response of second order systems and their specifications, steady state errors and error constants, Controllers and its applications: P, PI, PD, PID. **8**

Unit-III

Stability Analysis: Concept of stability, Routh-Hurwitz criteria and its limitations**,** Root locus concepts, construction of root loci. **6**

Unit-IV

Frequency response Analysis I: Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots. **6**

Unit-V

Frequency response Analysis II:

Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant. **4**

Text Books:

1. Nagrath & Gopal, "Control System Engineering", 4th Edition, New age International.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
3. B.C. Kuo & Farid Golnaraghi, "Automatic Control System" Wiley IndiaLtd, 2008.
4. Norman S. Mise, Control System Engineering 4th edition, Wiley Publishing Co.
7. N.C. Jagan, " Control Systems", B.S. Publications, 2007.

PME-451 MANUFACTURING SCIENCE LAB -I

L	T	P
0	0	3

Experiment List:
Say minimum 8 experiments out of following (or similar experiment).

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testing (at least one such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging hand forging processes
7. Forging - power hammer study & operation
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.
12. Bending & spring back.
13. Powder metallurgy experiment.
14. Jigs & Fixture experiment.
15. Any other suitable experiment on manufacturing science / process / technique.

PME 452 MEASUREMENT & METROLOGY LAB

L	T	P
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Experiments: Minimum 8 out of following (or similar experiments)

1. Study & working of simple measuring instruments- Vernier calipers, Micrometer, Tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire methods.
3. Measurement of angle using Sine bar & slip gauges.
4. Study of limit gauges.
5. Study & angular measurement using level protector
6. Adjustment of spark plug gap using feeler gauges.
7. Study of dial indicator & its constructional details.
8. Use of dial indicator to check a shape run use.
9. Study and understanding of limits, fits & tolerances
10. Study of Pressure & Temperature measuring equipment.
11. Strain gauge measurement.
12. Speed measurement using stroboscope.
13. Flow measurement experiment
14. Vibration/work measuring experiment.
15. Experiment on Dynamometers.

PME-453 THERMODYNAMICS LAB

L	T	P
0	0	2

Experiments: Minimum 10 experiments out of following;

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 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 Ignition system of an I. C. engine
11. Study of Velocity compounded steam turbine
12. Study of Pressure compounded steam turbine
13. Study of Impulse & Reaction turbine
14. Study of steam Engine model.
15. Study of Gas Turbine Model
16. Any other suitable experiment on thermodynamics

PEE 454: CONTROL SYSTEM LAB

L	T	P
0	0	2

Note: The minimum of 10 experiments are to be performed from the following, out of which at least three should be software based.

1. To determine response of second order systems 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 study and calibrate temperature using resistance temperature detector (RTD)
4. To study DC position control system
5. To study synchro-transmitter and receiver and obtain output V/S input characteristics
6. To determine speed-torque characteristics of an ac servomotor.
7. To study performance of servo voltage stabilizer at various loads using load bank.
8. To study behavior of separately excited dc motor in open loop at various loads.

Software based experiments (Use MATLAB, LABVIEW software etc.)

9. To determine time domain response of a second order system for step input and obtain performance parameters.
10. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability.
11. To plot a Bode diagram of an open loop transfer function.
12. To draw a Nyquist plot of an open loop transfer functions and examine the stability of the closed loop system.