UTTARAKHAND TECHNICAL UNIVERSITY

Program: B. Tech- AUTOMOBILE ENGG.

Year: 2 Session: 2010 – 2011

Scheme and Evaluation Pattern

S.No	Course No.	Subject	Periods			Evaluation				Total Marks
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
Semester:3rd										
Theory										
1.	**TMA 301**	Mathematics-III	**3**	**1**	**0**	**30**	**20**	**50**	**100**	**150**
2.	**TCE 301**	Fluid Mechanics	**3**	**1**	**0**	**30**	**20**	**50**	**100**	**150**
3.	**TME 301**	Materials Science	**3**	**1**	**0**	**30**	**20**	**50**	**100**	**150**
4.	**TME 302**	**Engineering** Thermodynamics	**2**	**1**	**0**	**15**	**10**	**25**	**50**	**75**
5.	**TME 303**	**Solid** Mechanics	**3**	**1**	**0**	**30**	**20**	**50**	**100**	**150**
6.	**THU 301**	**Engineering Economics**	**2**	**1**	**0**	**15**	**10**	**25**	**50**	**75**
Practical/Design										
1.	**PME 351**	Material Science & Testing Lab	**0**	**0**	**4**	**0**	**0**	**25**	**25**	**50**
2.	**PCE 351**	Fluid Mechanics Lab	**0**	**0**	**2**	**0**	**0**	**25**	**25**	**50**
3.	**PME 352**	Machine Drawing-I	**0**	**0**	**2**	**0**	**0**	**50**	**50**	**100**
4.	**GP 301**	General Proficiency	**0**	**0**	**2**	**0**	**0**	**50**	**0**	**50**
Semester: 4th										
Theory										
S.No	**Course No.**	**Subject**	**Periods**			**Evaluation**				**Total Marks**
			L	**T**	**P**	**Sessional**			**External Exam**	
						CT	**TA**	**Total**		
1.	**TME 401**	Kinematics of Machines	**3**	**1**	**0**	**30**	**20**	**50**	**100**	**150**
2.	**TME 402**	Manufacturing Science-I	**3**	**1**	**0**	**30**	**20**	**50**	**100**	**150**
3.	**TME 403**	Measurement, Measurement and Control	**3**	**1**	**0**	**30**	**20**	**50**	**100**	**150**
4.	**EAU 404**	Automotive Chassis	**3**	**1**	**0**	**30**	**20**	**50**	**100**	**150**
5	**TME 405**	Industrial Engineering	**2**	**1**	**0**	**15**	**10**	**25**	**50**	**75**
6	**EAU 406**	IC Engines & Compressors	**3**	**1**	**0**	**30**	**20**	**50**	**100**	**150**
Practical/Design										
1.	**PME 452**	Manufacturing Science Lab-I	**0**	**0**	**6**	**0**	**0**	**25**	**25**	**50**
2	**PME 453**	Measurement & Metrology Lab	**0**	**0**	**2**	**0**	**0**	**25**	**25**	**50**
3.	**PME 456**	IC Engines & Compressors lab	**0**	**0**	**2**	**0**	**0**	**0**	**25**	**25**
5.	**GP 401**	General Proficiency						**50**		**50**

UTTARAKHAND TECHNICAL UNIVERSITY
Program: B. Tech- AUTOMOBILE ENGG.

Year:3 Session: 2011 – 2012

Scheme and Evaluation Pattern

UTTARAKHAND TECHNICAL UNIVERSITY

Program: B. Tech- AUTOMOBILE ENGG.

S.No	Course No.	Subject	Periods			Evaluation				Total Marks
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
Semester:5th										
Theory										
1.	TME – 502	Machine Design I	3	1	0	30	20	50	100	150
2.	TME– 503	Dynamics of Machine	3	1	0	30	20	50	100	150
3.	TME 504	Manufacturing Science II	3	1	0	30	20	50	100	150
4.	EAU – 504	Automotive Transmission	3	1	0	30	20	50	100	150
5.	TME– 505	Heat and Mass Transfer	3	1	0	30	20	50	100	150
6.	TCS – 507	Concepts Of Programming and OOPS	2	1	0	15	10	25	50	75
Practical/Design										
1.	PME-551	Theory of Machine and Design Lab	0	0	2	0	0	25	25	50
2.	PAU-552	Auto Mobile Engg.Lab I	0	0	2	0	0	0	25	25
3.	PME-555	Heat and Mass Transfer Lab	0	0	2	0	0	25	25	50
4.	PAU-556	Discipline	0	0	2	0	0	50	0	50
Semester: 6th										
Theory										
S.No	Course No.	Subject	Periods			Evaluation				Total Marks
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
1.	TME – 601	Operation Research	3	1	0	30	20	50	100	150
2.	TME- 602	Machine Design II	3	1	0	30	20	50	100	150
3.	EAU – 603	Automotive Engines and Components	3	1	0	30	20	50	100	150
4.	EAU– 604	Automotive Electrical And Electronic Systems	3	1	0	30	20	50	100	150
5.	EAU – 605	Automotive Fules and Combustion	3	1	0	30	20	50	100	150
6.	THU – 608	Principles of Management	2	1	0	15	10	25	50	75
Practical/Design										
1.	PAU-651	Auto Mobile Engg.Lab II	0	0	2	0	0	25	25	50
2	PAU652	Engine Testing Lab	0	0	2	0	0	25	25	50
3.	PAU-655	Fuel Testing Lab	0	0	2	0	0	0	25	25
4.	PAU-656	Discipline	0	0	2	0	0	50	0	50

Year: 4 Session: 2012 – 2013

Scheme and Evaluation Pattern

S.No	Course No.	Subject	Periods			Evaluation				Total Marks
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
Semester:7th										
Theory										
1.	EAU-701	Advanced IC Engine	3	1	0	30	20	50	100	150
2.	EAU– 702	Vehicle Body Engineering And Safety	3	1	0	30	20	50	100	150
3.	EAU– 703	Automotive Air Pollution And Control	3	1	0	30	20	50	100	150
4.		ELECTIVE-I	3	1	0	30	20	50	100	150
5.		Open Elective	3	1	0	30	20	50	100	150
Practical/Design										
1.	PAU -751	Project	0	0	4	0	0	50	50	100
2.	*PAU-752	Industrial Interaction and LMV driving Training	0	0	2	0	0	25	25	50
3.	PAU-753	SERVICE AND RECONDITIONING LAB	0	0	2	0	0	25	25	50
4.	PAU-754	Seminar	0	0	2	0	0	50	0	50
Semester: 8th										
Theory										
S.No	**Course No.**	**Subject**	**Periods**			**Evaluation**				**Total Marks**
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
1.	TAE – 801	Autotronic	3	1	0	30	20	50	100	150
2.	TAE-802	Simulation Of IC Engine Processes	3	1	0	30	20	50	100	150
3.		ELECTIVE-II	3	1	0	30	20	50	100	150
4.		ELECTIVE-III	3	1	0	30	20	50	100	150
Practical/Design										
1.	PAU-851	Project	0	0	6	0	0	100	200	300
2	PAU-854	CAD Lab	0	0	2	0	0	25	25	50
3.	PAU-805	Discipline	0	0	2	0	0	50	0	50

- **TO be conducted during vacations after VI Semester.**

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 **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. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. Jain, Iyenger & Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi , 2003.
3. J.N. Kapur, Mathematical Statistics, S. Chand & company Ltd.,2000

4. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House, 2002.
5. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
6. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.
8. Devi Prasad, An introduction to Numerical Analysis, Narosa Publication house, New Delhi,2006.
9. T. Veerajan & T. Ramchandran, Theory & Problems in Numerical Methods, TMH, New Delhi, 2004.
10. S.P.Gupta, Statistical Methods, Sultan and Sons, New Delhi, 2004.
11. Devore, Probability and Statistics, Thomson(Cengage) Learning, 2007.
12. Walpole, Myers, Myers & Ye, Probability and Statistics for Engineers & Scientists, PearsonEducation, 2003.

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 Book :

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. K.M.Gupta, Materials Science, Umesh Publication.
3. Van Vlash - Elements of Material Science & Engineering John Wiley & Sons.
4. V. Raghvan - Material Science, Prentice Hall.
5. Narula - Material Science, TMH.
6. Srivastava, Srinivasan - Science of Materials Engineering, NewAge Publication.

TME-302 : Engineering Themodynamics **L T P**
2 1 0

Unit – I:

Fundamental Concepts and Definitions:

Introduction and definition of thermodynamics, Dimensions and units, Microscopic and Macroscopic approaches, Systems, surroundings and universe, Concept of continuum, Control system boundary, control volume and control surface, Properties and state, Thermodynamic properties, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasi static process, Energy and its forms, Work and heat, Gas laws, Ideal gas, Real gas, Law of corresponding states, Dalton's law, Amagat's law, Property of mixture of gases. 6

Unit – II

Zeroth law of thermodynamics: Zeroth law of thermodynamics, Temperature and its' measurement, Temperature scales. 1

First law of thermodynamics: Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules' experiment, First law of thermodynamics, Internal energy and enthalpy, First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. First law analysis for closed system (non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer, Limitations of first law of thermodynamics, PMM-I. 5

Unit – III:

Second law: Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, thermodynamic temperature scale, PMM-II. 4

Unit – IV

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

4

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function. 3

Unit – V

Thermodynamic relations: Mathematical conditions for exact differentials. Maxwell Relations, Clapeyron Equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic & Isothermal compressibility. 4

References:

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 & sons.
4. Thermodynamics by J.P. Holman, McGraw Hill.
5. Engineering Thermodynamics by P.K.Nag, Tata Mc Graw Hill Pub.
6. Engineering Thermodynamics by Onkar Singh, New Age International Pub..
7. Thermal Engineering By R.K. Rajput, Laxmi Publication.
8. Engineering Thermodynamics by C.P. Arora.

TCE-301: FLUID MECHANICS **L T P**
3 1 0

Unit-I: Introduction :
Fluid and continuum, Physical properties of fluids, Rheology of fluids. 3

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, subcritical, 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. 6

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. 4

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. 4

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. 4

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. 5

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.6

References :

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. S.K.Agarwal: Fluid Mechanics & Machinery, TMH
5. Garde, R.J., " Fluid Mechanics through Problems", New Age International Pvt. Ltd, New Delhi, 2nd Edition.
6. Hunter Rouse, "Elementary Mechanics of Fluids", John Wiley & Sons. Omc. 1946
7. I.H.Shames, "Mechanics of Fluids", McGraw Hill, Int. Student, Education, 1988.
8. Vijay Gupta and S.K.Gupta, " Fluid Mechanics and its Applications", Wiley Eastern Ltd, 1984.
10. Modi, P.N., and Seth, S.H., "Hydraulics and Fluid Machines", Standard Book House, 1989.

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

References:
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. I. H. Shames, *Introduction to Solid Mechanics*, 2e, Prentice Hall, 1989
4. S. P. Timoshenko, *Strength of Materials*, vols. 1 & 2, CBS publ., 1986
5. 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.

References:
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.

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)**

References:

1. Theory of machines - Thomas Bevan, CBS Publication
2. Theory of machines and mechanisms- Shigley, Mc-Graw Hill
3. 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,
6. Theory of Machines – P L Balani, Khanna Publication
7. Theory of Machine – R. K. Bansal & J. S. Brar, Laxmi Publication

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, CO2 casting and Stir casting etc. 3

References :

1. Manufacturing Science by Ghosh and Mallik
2. Production Engg. Science by P.C. Pandey
3. Production Technology by R.K. Jain
4. Manufacturing Technology by P.N. Rao., TMH

TME -403 MECHANICAL MEASUREMENT AND COTROL **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, pneumalic & hydraulic systems. 1

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 Microkrator. 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. 7
Measurement and Inspection: Dimensional inspection – Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection.

Unit-V: Control:

Introduction: Concept of Automatic Controls- Open loop & closed loop systems. Servomechanism. Block diagrams, transfer function. Applications of Laplace-Transform in control systems with simple examples/numerical. 5

Representation of Control Components & Systems: Translation & rotational mechanical components, series & parallel combinations, cascade system, analogous system. 2

Controllers: Brief introduction to Pneumatic, Hydraulic and Electric controllers. 1

References:

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, 1990.
3. Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.
4. Hume K.J., "Engineering Metrology", MacDonald and Co. 1963
5. Gupta, I.C., "Engineering Metrology", Dhanpat Rai & Sons, New Delhi, 1994
6. Sirohi, "Mechanical Measurement" New Age Publishers
7. Jain, R.K., "Engineering Metrology" Khanna Publishers
8. Jain, R.K., "Mechanical Measurement" Khanna Publishers
9. Raven, Automatic Cotrol Theory, Mc-Graw Hill Publisher
10.Nagrath and Gopal, Control System Engineering, New Age Publications

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3	1	0

EAU-404 AUTOMOTIVE CHASSIS AND SUSPENSION

UNIT-1 Introduction:
General consideration relating to chassis layout, power location, types of automobiles, layout of an automobile with reference to power plant, weight distribution, stability, Numerical problems.

5

Frames:
Types of frames – Two, Three, four wheelers & HV, general form & dimensions, materials, frame stresses, frame sections, cross members, proportions of channel sections, constructional details, loading points, subframes, passenger car frames, X member type frame, Box section type frame, testing of frames, bending and torsion test, effect of brake application of frame stresses, truck frames, defects, Numerical problems.

5

UNIT-2 Front axle and steering systems:
Axle parts and materials, loads and stresses, centre sections, section near steering head, spring pads, front axle loads, steering heads, factors of wheel alignment, wheel balancing, centre point steering, correct steering angle, steering mechanisms, cornering force, self righting torque, under steer and over steer, Steering linkages, steering gears, special steering columns, power steering, trouble shooting, Numerical problems.

7

UNIT-3 Brakes-1
Necessity, stopping distance and time, brake efficiency, weight transfer, brake shoe theory, determination of braking torque, classification of brakes, types, construction, function, operation, braking systems - mechanical, hydraulic, disc, drum, details of hydraulic system, mechanical system and components, types of master & wheel cylinders, bleeding of brakes, brake drums, brake linings, brake fluid, factors influencing operation of brakes such as operating temperature, lining, brake clearance, pedal pressure, linkages etc, Numerical problems. **8**

Brakes-2
Brake compensation, Parking and emergency brakes, hill holder, automatic adjustment, servo brakes, Power brakes-Air brakes, vacuum brakes and electric brakes and components brake valve, unloaded valve, diaphragm, air-hydraulic brakes, vacuum boosted hydraulic brakes, trouble shooting **6**

UNIT-4 Suspension:
Objects, basic considerations, Types of suspension springs, construction , operation & materials, leaf springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension, front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting, Numerical problems. **6**

Unit- 5 Wheels and Tyres:
Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section & designation, factors affecting tyre life, quick change wheels, special wheels, trouble shooting'

6

REFRENCES:
1. Automotive Chassis – P.M. Heldt, Chilton & Co.
2. Automotive Mechanics – N.K. Giri , Khanna Publications

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. 5

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-Grow-Hall Co.
2. Manufacturing Management-J Moore Prentice Hall Englewoon cliffs :New Jersey.
3. Modern production operations Management-Buffam E.S. Wiley eastern.
4. Industrial Engg. & Management O.P. Khanna.

EAU 406 I C ENGINES AND COMPRESSORS **L T P**
3 1 0

Unit-1

Introduction to I.C Engines:
Engine classification, Air standard cycles, Otto, Diesel, Stirling, Ericsson cycles, Actual Cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine. **5**

Fuels & Combustion:
Fuels for SI and CI engine , important qualities of SI engine fuels, Rating of SI engine fuels, Important qualities of CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. **3**
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. **4**

Unit–2

SI Engines:
Carburetion, Mixture requirements, Carburetor types Theory of carburetor, MPFI. **3**
Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines. **2**

Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition, battery and its types, Charging and discharging of batteries **2**

Unit–3 CI Engine:
Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. **4**
Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines. **2**
Scavenging in 2 Stroke engines, pollution and it's control. **2**

Unit-4

Engine Cooling: Different cooling systems, Cooling Towers, Radiators and cooling fans. **2**

Lubrication: Engine friction, Lubrication principal, Type of lubrication ,Lubrication oils, Crankcase ventilation. **2**

Supercharging: Effect of altitude on power output, Types of supercharging. **2**

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines. **4**

Compressors:
Classification, Reciprocating compressors, Single and multi stage, Intercooling, Volumetric efficiency. **3**

Rotary compressors, Classification, Centrifugal compressor, Elementary theory ,Vector Diagram efficiencies, Elementary analysis of axial compressors. **4**

Unit 5:
Vapour Power cycles: Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle,Modified Rankine Cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles. **3**

Gas Power Cycle: 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. **4**

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:
Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing COIC
Engines, by Rogowsky, international Book Co.
A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications Czechoslovakia .
I.C Engine Analysis & Practice by E.F Obert.
I.C Engine, by Ganeshan, Tata Mc Graw Hill Publishers.
I.C Engine, by R. Yadav, Central Publishing House, Allahabad

PME-452 MANUFACTURING SCIENCE 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 testings (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 453 MEASUREMENT & METROLOGY LAB **L T P**
0 0 3

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.

UTTARAKHAND TECHNICAL UNIVERSITY
Program: B. Tech- AUTOMOBILE ENGG.

Year:3 Session: 2011 – 2012

Scheme and Evaluation Pattern

UTTARAKHAND TECHNICAL UNIVERSITY

Program: B. Tech- AUTOMOBILE ENGG.

S.No	Course No.	Subject	Periods			Evaluation				Total Marks
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
Semester:5th										
Theory										
1.	TME – 502	Machine Design I	3	1	0	30	20	50	100	150
2.	TME– 503	Dynamics of Machine	3	1	0	30	20	50	100	150
3.	TME 504	Manufacturing Science II	3	1	0	30	20	50	100	150
4.	EAU – 504	Automotive Transmission	3	1	0	30	20	50	100	150
5.	TME– 505	Heat and Mass Transfer	3	1	0	30	20	50	100	150
6.	TCS – 507	Concepts Of Programming and OOPS	2	1	0	15	10	25	50	75
Practical/Design										
1.	PME-551	Theory of Machine and Design Lab	0	0	2	0	0	25	25	50
2.	PAU-552	Auto Mobile Engg.Lab I	0	0	2	0	0	0	25	25
3.	PME-555	Heat and Mass Transfer Lab	0	0	2	0	0	25	25	50
4.	PAU-556	Discipline	0	0	2	0	0	50	0	50
Semester: 6th										
Theory										
S.No	Course No.	Subject	Periods			Evaluation				Total Marks
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
1.	TME – 601	Operation Research	3	1	0	30	20	50	100	150
2.	TME- 602	Machine Design II	3	1	0	30	20	50	100	150
3.	EAU – 603	Automotive Engines and Components	3	1	0	30	20	50	100	150
4.	EAU– 604	Automotive Electrical And Electronic Systems	3	1	0	30	20	50	100	150
5.	EAU – 605	Automotive Fules and Combustion	3	1	0	30	20	50	100	150
6.	THU – 608	Principles of Management	2	1	0	15	10	25	50	75
Practical/Design										
1.	PAU-651	Auto Mobile Engg.Lab II	0	0	2	0	0	25	25	50
2	PAU652	Engine Testing Lab	0	0	2	0	0	25	25	50
3.	PAU-655	Fuel Testing Lab	0	0	2	0	0	0	25	25
4.	PAU-656	Discipline	0	0	2	0	0	50	0	50

Year: 4 Session: 2012 – 2013

Scheme and Evaluation Pattern

S.No	Course No.	Subject	Periods			Evaluation				Total Marks
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
Semester:7th										
Theory										
1.	EAU-701	Advanced IC Engine	3	1	0	30	20	50	100	150
2.	EAU– 702	Vehicle Body Engineering And Safety	3	1	0	30	20	50	100	150
3.	EAU– 703	Automotive Air Pollution And Control	3	1	0	30	20	50	100	150
4.		ELECTIVE-I	3	1	0	30	20	50	100	150
5.		Open Elective	3	1	0	30	20	50	100	150
Practical/Design										
1.	PAU -751	Project	0	0	4	0	0	50	50	100
2.	*PAU-752	Industrial Interaction and LMV driving Training	0	0	2	0	0	25	25	50
3.	PAU-753	Service And Reconditioning Lab	0	0	2	0	0	25	25	50
4.	PAU-754	Seminar	0	0	2	0	0	50	0	50
Semester: 8th										
Theory										
S.No	Course No.	Subject	Periods			Evaluation				Total Marks
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
1.	TAE – 801	Autotronic	3	1	0	30	20	50	100	150
2.	TAE-802	Simulation Of IC Engine Processes	3	1	0	30	20	50	100	150
3.		ELECTIVE-II	3	1	0	30	20	50	100	150
4.		ELECTIVE-III	3	1	0	30	20	50	100	150
Practical/Design										
1.	PAU-851	Project	0	0	6	0	0	100	200	300
2	PAU-854	CAD Lab	0	0	2	0	0	25	25	50
3.	PAU-805	Discipline	0	0	2	0	0	50	0	50

- **TO be conducted during vacations after VI Semester.**

TME-504 MANUFACTURING SCIENCE-II ` **L T P**
3 1 0

Unit-I

A Metal Cutting and Machine Tools

Metal Cutting-
Mechanics of metal cutting. Geometry of tool and nomenclature .ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting. **8**

Unit-II

Machine Tools
(i) Lathe : Principle, types, operations, Turret/capstan, semi/Automatic, Tool layout. **2**
(ii) Shaper, slotter, planer : operations & drives. **1**
(iii) Milling : Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. **2**
(iv) Drilling and boring : Drilling, boring, reaming tools. Geometry of twist drills. **2**

Unit-III

Grinding & Super finishing
(v) Grinding : Grinding wheels, abrasive, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding. **4**
(vi) Super finishing : Honing, lapping, polishing. **1**

Limits, Fits & Tolerance and Surface-roughness:
Introduction to Limits, Fits, Tolerances and IS standards, and surface-roughness. **3**

Unit-IV

B. Metal Joining (Welding)
Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding : Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing . **8**

Thermodynamic and Metallurgical aspects in welding and weld,. Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ. **3**

Unit-V

C. Introduction to non conventional Manufacturing Process

Benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding application such as LBW, USW, EBW, Plasma arc welding, Explosive welding. HERE- Explosive Forming **6**

Books

1. Manufacturing science by Ghosh and Mullick
2. Production Technology by R.K. Jain
3. Modern Machining Processes by P.C. Pandey & H.S. Shan
4. Manufacturing science by Degarmo
5. Manufacturing Technology Metal Cutting & Machine Tools by PN Rao, TMH
6. Manufacturing Technology Foundary, Forming & Welding by PN Rao, TMH

TME-502 **L T P**
3 1 0

MACHINE DESIGN -I

UNIT-I

Introduction, Definition, Methods, standards in design & selection of preferred size. 3

Selection of materials for static & fatigue loads, Materials for components subjected to creep, BIS system of designation of steels, steels, plastics & rubbers. AISI (American Iron & Steel Institution), ASTM rubber testing methods. 4

UNIT-II

Design against static load.

Modes of failure, Factor of safety, stress-strain relationship, principal stresses, theories of failure 4

Design against fluctuating load stress concentration, stress concentration factors, Fluctuating/alternting stresses, fatigue failure, endurance limit, design for finite & infinite life,
Soderberg & Goodman criteria. 4

UNIT-III

Joints

Welded joint, screwed joints, ecentric loading of above joints, design for fatigue loading. 3

Shaft, keys & coupling.

Design against static and fatigue loads, strength & rigidity design, Selection of square & flat keys & splines, rigid & flexible couplings. 4

UNIT-IV

Mechanical springs

Design of Helical and leaf springs, against static & fatigue loading. 4

Design analysis of Power Screws

Form of threads, square threads, trapezoidal threads, stresses in screw, design of screw jack. 4

UNIT-V

Introduction to Product Development & Design Process

Definition of Design, Design Process, Need Analysis, Need based developments, Design by
Evolution, Technology based developments, Examples. Case Studies. Brain-storming. 8

Books

1. Design of M/c Elements : Bhandari, TMH
2. Machine design : Sharma & Agarwal, Kataria
3. M/C Design : Maleev & Hartman,
4. Machine Design SI edition by Shigley, Mcgraw Hill

L	T	P
3	1	0

TME-503

DYNAMICS OF MACHINES

UNIT-I
Force Analysis, Turning Moment & Fly wheel:
Static force analysis of linkages, Equivalent offset inertia force, Dynamic analysis of slider crank & Bar mechanism. Piston and Crank effort, Inertia, Torque, Turning moment diagrams, Fluctuation of energy, Flywheel. 4

UNIT-II
Balancing of machines:
Static and dynamic balancing, Balancing of rotating and reciprocating masses, Primary and secondary forces and couples. **5**

UNIT-III
Friction:
Pivot and collar friction, Friction circle, Single plate, Multiplate and Cone clutches, Michelle & Kingsbury thrust bearing and rolling contact bearing, Belts and pulleys, Flat and V-belts, Design and selection. **7**

Brakes and Dynamometers (Mechanical Type):
External and internal shoe brakes, Band and Block brakes, Hydraulic brakes, Absorption and Transmission dynamometers. **7**

UNIT-IV
Governors:
Dead weight and spring loaded governors, Sensitivity, Stability, Hunting, Isochronism, Effort and Power, Friction and Insensitivity, Introduction to inertia governors. **6**

UNIT - V
Gyroscopic Motion:
Principles, Gyroscopic acceleration, Gyroscopic couple and Reaction. Effect of gyroscopic couple upon the stability of aeroplanes, ship, two & four wheelers. **4**

Books and References
1.Theory of Machine: Thomas Bevan (ELBS/CBS pub. New Delhi)
2.Theory of Machine: S.S.Ratan (TMH)
3. Mechanisms & Dynamics of Machines-Mabie

EAU-504:AUTOMOTIVE TRANSMISSION **L T P**

3 1 0

UNIT 1:

Transmission requirements: requirements of transmission system, general arrangement of power transmission, general arrangement of rear-engine vehicle with live axles, general arrangement of dead-axle and axles transmission; four-wheel-drive transmission. 5

Unit 2:

Clutches :Requirements of clutches, principle of friction clutches, types of clutches and materials used-cone, single-plate, diaphragm-spring, multi-plate, centrifugal, over-running and ferlecelectromagnetic clutch. 6

Unit 3: Gear box: Need of gear boxes, types- sliding mesh, constant mesh and epicyclic, gear boxes; synchronizers: principle, and design of gear box; Hydrodynamic drive: Advantages and limitations, principle of fluid coupling, constructional details, torque-capacity performance characteristics, drag torque, methods of minimizing drag torque; Torque converter: performance characteristics; single, , converter-coupling-performance characteristics, 10

Unit-4:

Transmission systems-Drive line: Definition, forces & torques acting; types of drives-Hotchkiss, torque tube & radius rod drives; components- propeller shaft, slip joint, universal joints & constant velocity universal joints; front wheel drive; Final drive: definition; types- worm-wheel, straight-bevel gear, spiral-bevel gear & hypoid-gear drives; double-reduction & twin-speed final drives 7

Differential:

Function, principle, construction and working; non-slip differential; differential lock; rear axle- loads acting & types; multi-axled vehicles. 5

Unit 5:

Automatic transmission: Hydraulic control system of automatic transmission; Electric drive: advantages and limitations, principle of , modern electric drive for buses; performance characteristics. 7

References:

1 Heldt P.M.; Torque converters; Chilton Book Co.

2 Giri NK; Automobile Engineering; Khanna Publisher

3 .Newton, Steeds & Garret; Motor Vehicles; B.H. Publication.

4. Judge, A.W., Modern Transmission Systems, Chapman & Hall Ltd.

5. Check Chart; Automatic Transmission; Harper & Row Publication.

TME-505

L	T	P
3	1	0

HEAT & MASS TRANSFER

UNIT-1

Introduction to Heat Transfer:

Concepts of the mechanisms of heat flows: conduction, convection and radiation; effect Of temperature on thermal conductivity of materials; introduction to combined heat transfer mechanism. 2

Conduction :

One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; initial and boundary conditions. 3

Steady State one-dimensional Heat conduction :

Composite Systems in rectangular, cylindrical and spherical coordinates with and without Energy generation; thermal resistance concept; Analogy between heat and electricity flow; thermal contact resistance; critical thickness of insulation. 3

UNIT-2

Fins of uniform cross-sectional area; errors of measurement of temperature in thermometer wells . 2

Transient Conduction:

Transient heat conduction Lumped capacitance method, Time constant unsteady state heat conduction in one dimension only, Heisler charts. 4

UNIT-3

Forced Convection:

Basic concepts; hydrodynamic boundary layer; thermal boundary layer, flow over a flat plate; flow
across a single cylinder and a sphere; flow inside ducts; empirical heat transfer relations; relation
between fluid friction and heat transfer; liquid metal heat transfer. 4

Natural Convection :

5

Physical mechanism of natural convection; buoyant force; empirical heat transfer relations for natural
convection over vertical planes and cylinders, horizontal plates and aylinders, and sphere. 3

UNIT-4

Thermal Radiation :

Basic radiation concepts; radiation properties of surfaces; black body radiation laws; shape factor;
black-body radiation exchange; Radiation exchange between diffuse nonblackbodies in an enclosure;
radiation shields; solar radiation. 7

UNIT-5

Heat Exchanger :

Types of heat exchangers; fouling factors; overall heat transfer coefficient; logarithmic mean

temperature difference (LMTD) method; effectiveness-NTU method; compact heat exchangers. 4

Condensation And Boiling :

Introduction to condensation phenomena; heat transfer relations for laminar film condensation on
vertical surfaces and on a horizontal tube; Boiling modes pool boiling, curve, forced convective boiling. 3

Introduction To Mass Transfer :

Introduction; Flick's law of diffusion; steady state equimolar counter diffusion; steady state diffusion
though a stagnant gas film. 2

Books

1. Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer By J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.

TCS-507 CONCEPTS OF PROGRAMMING AND OOPS

L	T	P
2	1	0

UNIT 1

UTILIZATION: Developer fundamentals such as editor, integrated programming environment, UNIX shell, modules, libraries.

PROGRAMMING FEATURES: Machine representation, primitive types, arrays and records, objects, expressions, control statements, iteration, procedures, functions, and basic I/O.

APPLICATIONS: Sample problems in engineering, science, text processing, and numerical methods. 5

UNIT 2

PROBLEM SOLVING WITH ALGORITHMS- Programming styles – Coding Standards and Best practices - Introduction to C Programming, Testing and Debugging. Code reviews, System Development Methodologies – Software development Models, User interface Design – introduction – The process – Elements of UI design & reports. 5

UNIT 3

OBJECTED ORIENTED CONCEPTS – object oriented programming, UML Class Diagrams– relationship – Inheritance – Abstract classes – polymorphism, Object Oriented Design methodology - Common Base class, Alice Tool – Application of OOC using Alice tool. 4

UNIT 4

RDBMS- DATA PROCESSING – the database technology – data models, ER modeling concept – notations – Extended ER features, Logical database design – normalization, SQL – DDL statements – DML statements – DCL statements, Writing Simple queries – SQL Tuning techniques – Embedded SQL – OLTP 4

TEXTBOOK:

C++ Program Design: An introduction to Programming and Object-Oriented Design, 3rd Edition, by Cohoon and Davidson, Tata McGraw Hill. 2003. 5

OTHER REFERENCES (Not required reading):

Thinking in C++ 2nd Edition by Bruce Eckel(available online)
G. Dromey, How to Solve It by Computer, Prentice-Hall, Inc., Upper Saddle River, NJ, 1982.
Polya, G., How to Solve _It (2nd ed.), Doubleday and co. (1957).
Let Us C. Yashwant Kanetkar. Allied Publishers, 1998.
The Java Tutorial, Sun Microsystems. Addison-Wesley, 1999.

PME 551 **L T P**
0 0 2

THEORY OF MACHINE & DESIGN LAB
(Say min 3 out of these)

1. Design & drawing of a cotter joint.
2. Design & drawing of a knuckle joints.
3. Design & drawing of a simple screw jack.
4. Design of shaft for different loading conditions.
5. Design & drawing of rigid coupling(flanged type).
6. Design & drawing of a leaf spring for an automobile.
7. Design & drawing of a helical spring for a given application

Note -

1. Students may be advised to use design data book for design.
2. Drawing shall be made wherever necessary on small drawing sheets.

Min. 5 out of following (or such) experiments to be done:

1. Study of simple linkers/models/mechanisms.
2. Exp. on Velocity acceleration.
3. Exp. on cam.
4. Exp. on Governor.
5. Exp. on critical speed of shaft (whirling of shaft)
6. Exp. on Gyroscope
7. Exp. on Balancing (static & dynamic)
8. Exp. on 4-bar mechanism
9. Exp. on Gears (tooth profile, interference etc.)
10. Exp. on Gear trains.
11. Exp. on Mechanism
15. Exp. on Vibration (spring)

PAE-552

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AUTOMOBILE ENGG. LAB. -I

1. Study of hand tools- sketching, materials used and their applications.
2. Writing technical specifications and description of all types of automobile engines.
3. Study of traffic rules as per M.V. Act 1988 and driving practice of four wheel vehicle.
4. Trouble shooting charts for all engine components.
5. Note the specifications of given engines and component standard dimensions. Dismantle & assemble of engine components of SI and CI engines (Two stroke and four stroke engines) of any commercial vehicles,
using special tools needed. Note procedure of dismantling & assembly; identify the major components, noting their functions & materials used. Measurement & comparison of major components dimension with
standard specifications. Inspection for wear and tear, crack, breakdown. Identify the service requirements of
engine, such as decarburizing, degreasing, sparkplug cleaning, fuel injector cleaning, etc.
6. Compression test, vacuum test on diesel and petrol engines.
7. Study (Dismantling & assembly): Different carburetors, fuel injection pumps, injectors, fuel tanks, fuel filters, fuel pumps, turbo-chargers, cooling systems and lubricating systems. Identify location of above components in a vehicle and note their functions along with the brand names.

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PME-555
HEAT & MASS TRANSFER - LAB
(min 8 experiment of the following or such experiment)

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection .
7. Convection - Heat transfer through tube/fin-forced convection.
8. Any experiment - Such as on Stefen's Law,
on radiation detrmination of emissivity, etc.
9. Any experiment - Such as on solar collector, etc.
on radiation
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable exp such as on critical insultation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

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3	1	0

TAE-601 :OPERATIONS RESEARCH

Unit-I

Linear Programming-

Introduction & Scope, Problem formulation, Simplex methods, primal & dual problem 8

Unit-II

Transportation & Assignment problems. 4

Unit-III

Decision theory-

Decision under various conditions. 4

Game Theory-

Minimax & maximum strategies. Application of linear programming. 4

Unit-IV

Stochastic inventory models-

Single & multi period models with continuous & discrete demands, 8

Unit-V

Simulations-

Simulation V/S mathematical modeling, Monte carlo simulation, simulation languages, 4

Queing models-

Introduction Model types, M.M. 1 & M/M/S system cost consideration 4

Referance Books

Operations Research by : Wangner
Production Planning of Operation Management : by Buffa.
Optimization Techniques by : S.S. Rao.
Operations Research by : Taha

TME-602 : MACHINE DESIGN-II **L T P**
3 1 0

UNIT I

Spur Gears Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards. **5**

Helical Gears Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears. **3**

Worm Gears Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing **3**

UNIT II

Sliding Contact Bearing Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing**,** **5**

Rolling Contact Bearing Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing **6**

UNIT III

IC ENGINE PARTS

Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft 6

References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications

2. Design of Machine Memebers-Alex Valance and VI Doughtie, McGraw Hill Co.

3. Machine design-M.F. Spott, Prentice Hall India

4. Machine Design-Maleev and Hartman, CBS

5. Machine design -Black & Adams, Mc Graw Hill

6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons

7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

EAU-603: AUTOMOTIVE ENGINES AND COMPONENTS **L T P**
3 1 0

UNIT-I

Review of IC engines,

Principles of engine operation (SI & CI), Port timing diagrams.
Types - Three port engine, Separate pumps or blowers, Symmetrical & unsymmetrical timing, Cross flow, loop flow & uniflow type Scavenging systems. Scavenging Process – Pre blow down, Blow down, Scavenging, Additional Charging. Theoretical Scavenging processes, Scavenging parameters, Comparison of Different Scavenging Systems; port design, scavenging pumps. Relative merits & demerits of petrol & diesel engines. 7

UNIT II

Engine components

- Classification/types, function, materials, construction details, manufacturing, Troubles & Remedies and Design of major dimensions of the following engine components

Cylinder heads & Cylinder Block

Cylinder heads, Gaskets, cylinder wear, water jacket, Cylinder liners, and valve seats. Production of engine block – casting, cleaning, treatment, machining operations and transfer machines 3

Crank Case, Manifolds and Mufflers

Crank Case – General form of crank case, oil sumps and cooling features, flywheel mountings, Engine mountings, Front & Rear mountings. Manifolds and Mufflers - inlet and exhaust manifolds, mixture distribution, heating by exhaust gas, dual manifolds, General Design of Manifolds, effect of firing order, Mufflers, general design. 3

Piston, piston rings, piston pin

Piston Temperatures, piston slap, compensation of thermal expansion in pistons. Piston Rings, forms of gap, stresses in piston rings, ring collapse, heat treatment, piston ring selection, shape. Piston pin, locking of piston pins, length of piston. 3

UNIT III

Connecting rod

Length of rod, Cross section, Buckling, Drilled connecting rods, piston pin bearing, offset connecting rods, effects of whipping, bearing materials, lubrication . 2

Crank shaft

Balance weights, local balance, Crankshaft proportions, oil holes drilled in crank shafts, balancing , vibration dampers, firing order, bearings, lubrication. 2

Valve and valve mechanism

No. of Valves per cylinder, Angle of seat, Operating Conditions, operating temperatures, valve cooling, Sodium cooled valves, Valve rotators, valve seats, valve guides, , valve springs, valve clearance, valve timing, OHV, OHC, dual valves, types of valve operating mechanisms. Valve train component details, Camshaft,-drives of cams, cam types, tappets,-automatic zero clearance tappets, push rods, rocker arms & rocker Shaft. 4

REFERENCE BOOKS:

1. A course in I.C. Engine - Mathur & Sharma , Dhanpat Rai & Sons, Delhi, 1994
2. Internal Combustion Engines-V Ganesan, Tata McGraw Hill, Delhi, 2002
3. Automobile Engineering Vol. II - Kirpal Singh, Standard publications, New Delhi, 2005

EAU-604: AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS **L T P**
3 1 0

UNIT-1

Storage Battery:

Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, voltmeter, effect of temperature on electrolyte, its specific gravity, capacity and efficiency, methods of charging from D.C. mains, defects and remedies of batteries, care of idle and new batteries. Recent development in batteries 6

Generator/ Alternator:

Principle of generation of direct current, generator details, shunt, dynamos, armature reaction, action of three brush generator and battery in parallel, setting of third brush, voltage and current regulators, cutout - construction, working and adjustment. Construction of A.C. systems. 6

Starter Motor & Drives:

Battery motor starting system, condition at starting, behaviour of starter during starting series motor and its characteristics, consideration affecting size of motor, types of drives, starting circuit. 4

UNIT-II

Ignition systems:

Ignition fundamentals, Types of solid state ignition systems, components, construction And operating parameters high energy ignition distributors, Electronic spark timing And control. 4

UNIT-III

Wiring and Lighting system:

Earth return and insulated systems, 6volts and 12 volts system, fusing of circuits, low and high voltage automobile cables, diagram of typical wiring system. Principle of automobile illumination, head lamp mounting and construction, sealed beam auxiliary lightings, horn, windscreen-wipers, signaling devices, electrical fuel pump, fuel, oil and temperature gauge(Dash board instruments) 8

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UNIT-IV

Engine management Systems:

Combined ignition and fuel management systems. Exhaust emission control, Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation. Complete vehicle control systems, Artificial intelligence and engine management. Hybrid vehicles and fuel cells. 8

UNIT-V

Chassis Electrical systems:

Antilock brakes (ABS), Active suspension, Traction control, Electronic control of automatic transmission, other chassis electrical systems, Central locking, Air bags and seat belt tensioners. 8

REFERENCE BOOKS:

1. Tom Denton, "Automobile Electrical and Electronic systems" SAE publication, 2000.
2. P.M. Kohli, 'Automotive Electrical Equipment", Tata McGraw Hill, New Delhi.
3. Heinz Heisler, Advanced Engine Technology. SAE Publications, 1995

EAU-605 AUTOMOTIVE FUELS AND COMBUSTION **L T P**
3 1 0

UNIT-1

Energy Sources:
Exhaustible sources - crude oil, Natural gas, Inexhaustible sources - Solar energy, Wind power, Tidal Power, Geo-thermal power. Energy from Bio-gas, Synthetic fuels – Fuel Cells, Hydrogen- only a brief introduction. 3

UNIT-2

Liquid Fuels:
Origin of petroleum, its chemistry, normal paraffin's, isoparaffins, olefins, naphthalene and aromatics. Refining of petroleum: Fractional distillation, Cracking, Reforming process, Thermal reforming, polymerization, alkylation, and isomerisation. Properties and tests : Specific Gravity, viscosity, flash and fire points, calorific value, rating of fuels, vapour pressure, cloud and pour point, annealing point, diesel index, carbon residue and ash content determination 5

UNIT-3

Combustion of Fuels:
Combustion equation, conversion of gravimetric to volumetric analysis. Determination of theoretical minimum quantity of air for complete combustion. Determination of air fuel ratio for a given fuel. Numerical problems, flue gas analysis, gas Chromatograph. 4

UNIT-4

Petrol and Diesel Fuels:
Properties and rating of fuels, chemical energy of fuels, Reaction Equation, Properties of A/F mixture, combustion temp, combustion charts, Lead free gasoline's, low and ultra – low sulphur diesels, LPG, CNG,
Alcohols, Biodiesels, Gaseous Fuel Injections, Dual Fueling and Controls – CNG and Gasoline, Hydrogenand Diesel, Alcohols and Diesels etc.ENGINE PERFORMANCE: Performance parameters BHP, FHP, IHP, specific fuel consumption,volumetric efficiency, Thermal efficiency, heat Balance sheet, Testing of Engines, Numerical problems 5

UNIT-5
Cycle Analysis:
Otto, Diesel, Dual, sterling and Brayton cycles, comparison of air standard, fuel air and actual cycles, simple problems on the above topics. Rotary engines. Stirling engine, Stratified charge engine 3

Combustion in S.I Engines
Initiation of combustion, flame velocities, effect of variables on flame propagation, normal and abnormal combustion, knocking combustion, pre-ignition, knock and engine variables, detonation, effects of engine variables on combustion, control of detonation, CFR engine, features and design consideration of

combustion chambers, stratified charge combustion, concepts of lean burn engines, heat release correlations 4

Combustion in C.I. Engines

Various stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl, squish, tumble flow, velocities, swirl measurement, and delay period correlations, diesel knock and engine variables, features and design considerations of combustion chambers, types, heat release correlations. 3

REFERENCE BOOKS:

1.. Fuels & Combustion by S.P. Sharma & Chandra Mohan, Tata McGraw-Hill, New Delhi,1987
2. John B.Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Book, 1998
3. Obert, E.F., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 1983.
4. Ram lingam, K.K., Internal Combustion Engines, SciTech Publications (India) Pvt. Ltd., 2000.

THU-608 PRINCIPLES OF MANAGEMENT

L	T	P
2	1	0

UNIT 1

INTRODUCTION TO MANAGEMENT: Theories of management: Traditional behavioral, contingency and systems approach. Organization as a system. 4

UNIT 2

MANAGEMENT INFORMATION: Interaction with external environment. Managerial decision making and MIS. 3

UNIT 3

PLANNING APPROACH TO ORGANIZATIONAL ANALYSIS: design of organization structure; job design and enrichment; job evaluation and merit rating. 3

UNIT 4

MOTIVATION AND PRODUCTIVITY: Theories of motivation, leadership styles and managerial grid. Co-ordination, monitoring and control in organizations. Techniques of control. Japanese management techniques. Case studies. 4

References:

1. Peter Drucker, Harper and Row: The Practice of Management.
2. Koontz: Essentials of Management, PHI Learning.
3. Staner: Management, PHI Learning.
4. Daft: Principles of Management, Cengage Learning.
5. T. N. Chhabra: Principle and Practice of Management, Dhanpat Rai, New Delhi.

PAU-651 **L T P**
AUTOMOBILE ENGG. LAB -II **0 0 2**

1. Writing technical specifications and description of all types of chassis and transmission components of automobiles, including body and interiors (two wheeler, four wheeler and heavy vehicle – one each)
2. Trouble shooting charts for major parts like clutch, gear box, differential, brakes, and wheels with tyres,
steering system and suspension.
3. Testing and servicing of electrical components like battery, starting system, ignition system, central locking
system, lighting system, and alternator. Experiments on microprocessors related to automobiles
4. Dismantle and assemble of major systems (clutch system, Gear boxes, Propeller shaft, Differential, Front
and Rear axles, brake system, steering system and suspension system) and identifying remedies (like backlash adjustment, brakes adjustment, bleeding of brakes) for the possible problems based on trouble shooting charts.
5. Draw sketch of seating arrangements, seats for commercial vehicle and study the comfort levels provided
for driver and passengers.
6. Draw sketches of different mechanisms of door, seat adjustments mechanisms

L T P
PAU-652 **0 0 2**
ENGINE TESTING LAB

1. Testing of Single Cylinder, Twin Cylinder and multi cylinder SI / CI engines for performance, calculate
BP, Thermal, volumetric efficiencies, and BSFC with emission testing.
2. Study one engine performance by changing parameters like valve timing, ignition timing, carburetor nozzle jet.
3. Conduct Morse test for finding FP, IP, Indicated thermal efficiency and Mechanical efficiency.
4. Study of engine performance using alternate fuels like alcohol blends/ bio diesel / LPG.
5. Performance test on computerized IC engine test rig.
6. Study and testing on MPFI Engine and Variable compression Engine.
7. Tuning of engines. Study and practice on computerized engine analyzer.
8. Exhaust Emission test of Petrol and Diesel engines

L T P

PAU-655 **0 0 2**

FUEL TESING AND FLUID MECHANICS LAB

1. Determination of Flash and Fire Points of fuels and lubricants
2. Determination of calorific values of solid, liquid and gaseous fuels
3. Determination of viscosity of oils using Redwood, Say bolts and Torsion viscometer.
4. Measurement of areas of irregular figure Using of Plan meters
5. Determination of Carbon residue and Moisture content in a fuel.
6. Determination of cloud and pour points of light, medium and heavy oils.
7. Drawing of Valve and port timing diagram for a given engine.
8. Determination of compression ratio for a given engine.
9. Performance testing of fluid pumps.
10.Performance testing of air blower.
11.Determination of coefficient of discharge of venturi meter, orifice meter.
12.Determination of major and minor losses in pipe flow (bend, sudden expansion, sudden contraction,entry and exit).

EAU 017: ADVANCED I.C.ENGINES

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UNIT-1

Combustion in Spark Ignition Engines

Thermodynamic analysis of SI engine Combustion: Burned and unburned mixture states. Analysis of cylinder pressure data, Combustion process characterization, Flame structure and speed; flame structure, laminar burning speeds, flame propagation relations, Cyclic variations in combustion, partial burning and misfire: definitions, causes of cycle – by – cycle and cylinder to cylinder variations, partial burning, misfire and engine stability. Spark Ignition: Ignition fundamentals, conventional ignition systems, alternative ignition systems, alternative ignition approaches, Abnormal Combustion: knock and surface ignition, knock fundamentals, fuel factors. 8

UNIT-II

Combustion in Compression Ignition Engines

Types of diesel combustion systems: Direct injection systems, indirect injection systems, comparison of different combustion systems, Analysis cylinder pressure data; combustion efficiency, DI engines, IDI engines, Fuel spray behaviour: Fuel injection, overall spray structure, atomization, spray penetration, droplet size distribution and spray evaporation, Ignition delay: definitions and discussion, fuel ignition quality, auto ignition fundamentals, physical properties affecting delay, effect of fuel properties. 6

UNIT-III

Equilibrium charts:

Charts for burnt mixture, charts for unburned Mixture, transmission from unburned to burnt mixture, nonequilibrium Problems covering the above. 4

Modern Developments in I.C.Engines:

Lean burn engines, ceramic and adiabatic engines, Multi-valving, Tuned manifolding, camless valve gearing, variable valve timing, Turbo and supercharging – Waste gating, EGR, Part-load charge stratification in GDI systems. Sports vehicle engines, Stirling engines, MPFI engines – operation and performanance. 6

UNIT-IV

Special types of Engines;

Introduction to working of startified charged engines, Wankel engine, variable compression engine, Surface ignition engines, free piston engines, Current engines and future trends (e.g. Convergence of SI and CI engine technology, Control developments, fuel quality), Effect of air cleaners and silencers on engine performance. 6

UNIT-V

Gas Turbine combustion:

Simple brayton cycle, working of a gas turbine, modification of the simple cycle, intercooling reheat and regeneration, determination of efficiency and power output, numerical problems. 3

REFERENCE BOOKS:

1. Internal Combustion Engines Fundamentals - John B. Heywood, McGraw Hill International Edition,
1. I.C.Engines by Taylor, MIT Press England 1989
2. I.C.Engines By Lichty., McGraw Hill
3. Fuels & Combustion By Smith & Stinson., McGrawHill
4. Motor Vehicle Engines by M.Khovakh., Mir Publishers
5. I.C. Engines by V.Ganesan, Tata Mc Graw Hill,1994

L	T	P
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EAU-702: VEHICLE BODY ENGINEERING AND SAFETY

UNIT-I

Introduction:

Classification of coachwork type: styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, commercial vehicle types, Vans and Pick ups. Terms used in body building construction, Angle of approach, Angle of departure, Ground clearance, Cross bearers, Floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets 5

UNIT-II

Vehicle Body Materials:

Aluminium alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention. 4

UNIT-III

Aerodynamics:

Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles 8

Load distribution:

Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion. 6

UNIT-IV

Interior Ergonomics:

Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms. 8

UNIT-V

Vehicle Stability:

Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability. 4

Noise and vibration:

Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

Safety: Impact protection basics, Physics of impact between deformable bodies, Design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety. 4

REFERENCE BOOKS:

1. Sydney F page, "Body Engineering"' Chapman & Hall Ltd, London, 1956
2. John Fenton, "Vehicle body layout and analysis", Mechanical Engg. Publication ltd, London.
3. Automotive chassis by P.M. Heldt, Chilton & Co, 1970
4. Vehicle Safety 2002, Cornwell press, Townbridge, UK, ISBN 1356 -1448.

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EAU-703: AUTOMOTIVE AIR POLLUTION AND CONTROL

UNIT-I

Laws and regulations:

Historical background, regulatory test procedure (European cycles), Exhaust gas pollutants (European rail road limits), particulate pollutants, European statutory values, inspection of vehicle in circulation (influence of actual traffic conditions and influence of vehicle maintenance) 4

UNIT-II

Mechanism of pollutant formation in Engines

INTRODUCTION: NITROGEN OXIDES, formation of nitrogen oxides, kinetics of NO formation, formation of NO2, NO formation in spark ignition engines, NOx formation, in compression ignition engines CORBONMONOXIDE UNBURNED HYDROCARBON EMISSIONS Back ground, flame quenching and oxidation fundamentals, HC emissions from spark ignition engines, HC emission mechanisms in diesel engines
PARTICULATE EMISSIONS Spark ignition engine particulates, characteristics of diesel particulates, soot formation fundamentals, soot oxidation. Crankcase emissions, piston ring blow by, evaporative emissions 8

UNIT-III

Pollution control techniques:

Pollution control measures inside SI Engines & lean burn strategies, measures in engines to control Diesel Emissions ,Pollution control in SI & CI Engines, Design changes, optimization of operating factors and Exhaust gas recirculation, fuel additives to reduce smoke & particulates ,Road draught crankcase ventilation system, positive crankcase ventilation system, fuel evaporation control 5

Influence of Fuel Properties

Effect of petrol, Diesel Fuel, Alternative Fuels and lubricants on emissions 3

UNIT-IV

Post combustion Treatments

Available options, physical conditions & exhaust gas compositions before treatment, Catalytic mechanism, Thermal Reactions, Installation of catalyst in exhaust lines, catalyst poisoning, catalyst light-off, NOx treatment in Diesel Engines, particulate traps, Diesel Trap oxidizer. 4

Effect of air pollution

Effect of air pollution on Human Health, Effect of air pollution on animals, Effect of air pollution on plant 3

UNIT-V

Sampling procedures

Combustion gas sampling: continuous combustion, combustion in a cylinder
Particulate sampling: soot particles in a cylinder, soot in exhaust tube, Sampling Methodssedimentations, and filtration, and impinge methods- electrostatic precipitation thermal precipitation, centrifugal methods Determination of mass concentration, analytical methods-volumetric-gravimetric-calorimetric methods etc. 6

Instrumentation for pollution measurements
NDIR analyzers, Gas chromatograph, Thermal conductivity and flame ionization detectors, Analyzers for NOx, Orsat apparatus, Smoke measurement, comparison method, obscuration method, ringelmann chart, Continuous filter type smoke meter, Bosch smoke meter, Hart ridge smoke meter. 6

REFERANCE BOOKS;

1. Automobiles and pollution - Paul degobert (SAE)
1. Air pollution – M.N. Rao, and H. V. Rao
2. Internal combustion engines: V. Ganesan
3. Crouse William, Automotive Emission Control, Gregg Division /McGraw-Hill. 1980

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PAU-753: SERVICE AND RECONDITIONING LAB

1. Inspection of vehicles and preparation of test charts.
2. Tuning of Engines: Check for ignition timing, valve tappet clearance, Radiator flushing and check for leaks ete.,
3. Study and practice on
    - Connecting rod alignment
    - Cylinder reboring machine
    - Valve refacing machine
    - Nozzle grinding machine
    - Brake drum skimming machine
4. Servicing of components like FIP, Carburetor, Fuel pump, Exhaust pipes and Silencer, Lubricating system, Air compressor, shock absorber, Calibration of FIP.
5. Study and practice of wheel alignment (Mechanical and computerized) and wheel balancing
6. Testing of Two wheeled vehicles on chassis dynamometer
7. Study of tyre retreading and vulcanizing
8. Study and practice on body repairs – tinkering and painting
9. Head light focusing test and visibility test

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EAU-801: AUTOTRONICS

UNIT 1

Introduction to Mechatronic system

Definition of Mechatronics, Objective, Evolution of Mechatronics, An overview of Mechatronics systems, Measurement &Control systems their elements & functions. Need of Mechatronics in Industries , Advantages & disadvantages of Mechatronics, Microprocessor based controllers, Working principle of Engine management system. 5

Transducers and sensors

Definition and classification of Transducers. Definition and classification of sensors. Working Principle and applications of Light sensors, Proximity sensors and Hall effect sensors. 4

UNIT II

Electrical Actuation Systems

Actuator and actuator system. Classifications of actuator system with examples. Mechanical switches. Concept of bouncing, Methods of preventing bouncing of mechanical switches. Solenoids, Relays , Solid state switches - Diodes, Thyristors, Triacs, Transistors, Darlington pair. Electrical actuator, Principle, Construction and working of AC,DC motors, Stepper motors, Permanent magnet motors, servomotors, servo systems and control. 5

Signal Conditioning

Introduction to Signal conditioning, Operational amplifiers, Protection, filtering –Wheatstone bridge , Digital signals , Multiplexer. Data acquisition, Introduction to Digital signal processing, Pulse modulation. 5

UNIT III

Introduction to Microprocessors

Basic concepts, evolution of microprocessors, organization of microcomputers, microprocessor programming, Boolean algebra , Logic gates and Gate networks, Digital number system, Binary and Decimal number systems, memory representation of positive and negative integers , Maximum and minimum integers , Conversion of real numbers , Floating point notation, Representation of floating point numbers , Accuracy and range in floating point representation , Overflow and underflow , addition of floating point numbers , Character representation. 5

UNIT IV

Organization & Programming a Microprocessor

Organization of Intel 8085 microprocessor , Instruction set of the 8085, programming the 8085, Assembly language programming , programming examples 4

UNIT V

Microprocessor Timings & Interfacing memory & I/O devices

Microprocessor Timings Timing & Control unit, Timings of Intel 8085. Interfacing memory & I/O devices : Address space partitioning , memory interfacing 4

Applications of Mechatronics

A temperature monitoring system, Automotive applications 3

REFERENCE BOOKS:

1. "*Mechatronics* " – by W. Bolton, Longman Pearson publications ., 2nd Ed , 2007, Third Edition.
2. "Microprocessor Architecture, Programming – by R.S.Gaonkar, Wiley Eastern and Applications" with 8085/8085A
3. Mecharonics by Prof. H.D.Ramachandra , M/S Sudha publications, Bangalore
4. "*Mechatronics" principles, concepts and applications* – by Nitaigour & Premchand Mahalik, TATA
McGraw Hill - 2003

L	T	P
3	1	0

EAU-802: SIMULATION OF IC ENGINE PROCESSES

UNIT-1

INTRODUCTION

Principle of computer modeling and simulation, Monte Carlo simulation, Nature of computer modeling andsimulation. Limitations of simulation, areas of application. 6

SYSTEM AND ENVIRONMENT

components of a system-discrete and continuous systems. Models of a system-a variety of modeling approaches. 5

UNITII-

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS

Variance reduction techniques. Antithetic variables. Variables verification and validation of simulation models. 6

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS

Variance reduction techniques. Antithetic variables. Variables verification and validation of simulation models. 4

UNIT-III

COMBUSTION PROCESS – GENERAL

Heat of reaction – Adiabatic flame temperature – Temperature change due to fuel vaporization 5

UNIT-IV

COMBUSTION AND HEAT TRANSFER IN ENGINES

Combustion in diesel engines – Heat transfer in engines – Heat Transfer correlations. 5

UNIT-V

C.I. AND S.I. ENGINE SIMULATION

Simulation of Otto cycles under full load and part load and supercharged conditions. Progressive combustion, Exhaust and intake process analysis. 6

TWO STROKE ENGINE SIMULATION

Engine and porting geometry, gas flow, Scavenging. 4

ReferenceBooks:

1. V.Ganesan," ComputerSimulation of Spark Ignition Engine Processes", Universities Press,1995..
2.NARS1NGH DEO, “System Simulation with digital Computer", prentice Hall Of India,1979 ..
3. J.I.Ramos,. “Internal Combustion Engine Modeling" Hemisphere Publishing Corporation, 198

LIST OF ELECTIVE FOR VII SEM

EAU 011: VEHICLE TRANSPORT MANAGEMENT **L T**
3 1 0

UNIT-

Introduction: Historical background, the growth of a network, trams, trolley buses, buses, private cars, subsidies. Motor vehicle act 1988. 2

UNIT-II

The Infrastructure:

Road, Highway network, traffic control, Bus priorities, pedestrianization, out town shopping centers, Bus-stops,shelters, Bus stations-drive through type, head on type, facilities for passengers, bus garages, requirement, layout of premises, size, function, ,location, design, equipment, use of machinery, garage organization, large scaleoverhaul conveyance of staff, requirement of facilities at depot., legal provisions for depot. Layouts.Maintenance - preventive, breakdown, overhauling - major, minor, repair schedules & workshop, facilities,documentation, analysis & corrective maintenance schedules 6

Organization and Management:

Forms of ownership, municipal undertaking, company undertaking, traffic, secretarial and engineering deportments, management, principle of transport, - internal organization-centralized control, de-centralized control, staff administration: industrial relation, administration, recruitment and training, drivers and conductors duties, training of drivers and conductors, factors affecting punctuality, welfare, health and safety. 6

UNIT-III

Route planning:

Source of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule test runs, elimination of hazards, factors affecting frequency, direction of traffic flow, community of interest, estimating, traffic volume, probable weekday travelers, passengers during various periods of the day, estimated number of passengers, estimated traffic, possibility of single verses double deck and frequency Timing, Bus working and Schedules: Time table layout, uses of flat graph method of presentation, preparation of vehicle and crew schedule preparation of the duty roster, co-operation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements 8

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UNIT-IV

Fare collections & Fare structure:

Need, Principles of collection, tickets, the way bill, stage by stage, bell punch system, bellgraphic system, reduced ticket stocks will brew system, mechanical ticket machines, T.I.M and straight machines, Vero meter,one-man operation, two stream boarding, pre paid tickets, lenson parason coach tickets exchanges, the fare box, electronic ticket machines, box system personal and common stock flat fare platform

control.Fare structure: Basis of fares, historical background, effects of competition and control, calculating average zone system, concession fares, straight and tapered scale elastic and inelastic demand co-ordination of fares concessions fares changes for workman, standard layout of fare table, anomalies double booking inter availability through booking and summation, private hire charges. 8

UNIT-V

Operating cost and types of vehicles:
Classification of costs, average speed, running costs, supplementary costs, depreciation obsolescence, life of vehicles, sinking fund, factor affecting cost per vehicles mile incidence of wages and overheads, 100 seats miles basis, average seating capacity, vehicles size and spread overs, types of vehicle economic considerations authorization of trolley, bus services, statuary procedure taxes and hire car. 6

Reference books:
1. Bus operation - L.D.Kitchen, Iliffe & Sons , London
2. Bus & coach operation - Rex W. Faulks, Butterworth Version Of 1987, London
1. Compendium of transport terms - Cirt,Pune
2. M.V. Act 1988 - Central Law Agency, Allahabad
3. The elements of transportation - R.J. Eaton

EAU 012: TWO AND THREE WHEELED VEHICLES

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UNIT 1:

The Power Unit:

Types of engines for two wheelers, advantages and disadvantages of two stroke and four stroke engines, engine components, constructional details, materials, symmetrical and unsymmetrical port timing diagrams,valve actuating mechanisms, valve timing diagrams. Rotary valve engine, Advantages and disadvantages of diesel engines for two wheelers, power plant for electric bikes, exhaust systems. 5

UNIT II:

Transmission system:

Primary drive and Clutch:Motor cycle power train, Primary drives, Types of primary drives, Chain drive, Gear drive, Construction and operation of motorcycle clutches, Clutch release mechanism.
Gear boxes and Transmision: Introduction to motorcycle transmission, Sprockets and chain, Gears and Dogs in motor cycle transmission, Gear and Gear ratios, Sliding gear transmissions, Shifting fork mechanisms, Constant mesh transmissions, lubrication, final drive: Introduction to motorcycle final drives, Fundamentals of chain drive, Chain lubrication and
lubricators, Shaft drives, Drive shaft couplings, Final drive gear case, 6

UNIT III**:**

Frames and suspension:

Types and constructional details of frames, advantages and limitations, frame materials, frame stresses, frame building problems, frame components, Front and Rear suspension systems, shock absorber construction and working, Panel meters and controls on handle bar, body manufacture and painting.

Brakes and Wheels:

Front and rear braking systems, disc and drum brakes, merits and demerits. Types of wheels, loads on wheels, construction and materials for wheels, wheels designation. Tyre designation, inflation, types of tyres, construction details. 8

UNIT IV:

Electrical system:

Types of ignition system, their working principles, wiring diagram for Indian vehicles, spark plug construction, indicators and gauges used in two wheelers, lighting systems. 2

UNIT V:

Two wheelers and Three wheelers:

Case study of major Indian models of major motor cycles, scooters, scooteretts and mopeds.

Case study of Indian models of three wheelers, Front mounted engine and rear mounted engine types, Auto rickshaws, pick up van, delivery van and trailer, Bijili electric vehicles. 4

References Books:

1. P.E.IRVING, “Motor cycle engines”, Temple Press Book, London, 1992
2. Motor cycles -Michel M Griffin
3. William H. Crouse and Donald L. Anglin, “Motor cycle Mechanics”,
1. “The cycle Motor manual”, Temple Press Ltd, 1990
2. Bryaut R. V. “Vespa maintenance and repair series.
3. “Encyclopedia of Motor Cycling 20 volumes”, Marshall Cavendish, New York and London, 1989

EAU 013 NON – TRADITIONAL MACHINING **L T P**
3 1 0

Unit 1:

Introduction:
History, Classification, comparison between conventional and Non-conventional machining process Selection . 2

Unit 2:

Ultra sonic machine(USM):
Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Effect of parameter: Effect of amplitude and frequency and vibration, Effect of grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM. 3

Unit 3:

Abrasive Jet Machining (AJM):
Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean No. abrasive particles per unit volume of the carrier gas, work material, stand off distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining **:** Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery 6

Unit 4:

Electrochemical machining (ECM):
Introduction , study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations. 6

Unit 5:

Chemical Machining (CHM) :
Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: ;material removal rate accuracy, surface finish, Hydrogen embrittlement,

advantages & application of CHM. 5

Plasma Arc Machining (PAM):
Introduction, equipment non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations . 4

Laser Beam Machining (LBM):
Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations. 2

Reference Books:

1. **Modern machining process,** by PANDEY AND SHAN, TATA McGraw Hill 2000
2. New technology by BHATTACHARAYA 2000
3. **Production Technology,** by HMT TATA McGraw Hill. 2001
4. Modern Machining Process by ADITYA. 2002

EAU 014 COMPUTER INTEGRATED MANUFACTURING **L T P**
3 1 0

Unit 1:

Computer Integrated Manufacturing Systems :
Introduction, Automation definition, Types of automation, CIM, processing in manufacturing, Production concepts, Mathematical Models-Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, Work-in-process, WIP ratio, TIP ratio, Problems using mathematical model equations. 4

Unit 2:

High Volume Production System:
Introduction Automated flow line-symbols, objectives, Work part transport-continuous, Intermittent, synchronous, Pallet fixtures, Transfer Mechanism-Linear-Walking beam, roller chain drive, Rotary-rack and pinion, Rachet & Pawl, Geneva wheel, Buffer storage, control functions-sequence, safety, Quality, Automation for machining operation. 4

Unit 3:

Analysis of Automated Flow line & Line Balancing :
General terminology and analysis, Analysis of Transfer Line with Out storage-upper bound approach, lower
bound approach and problems, Analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with example problem, Partial automation-with numerical problem example, flow lines with more
than two stage, Manual Assembly lines line balancing problem. 3

Minimum rational work element:
work station process time, Cycle time, precedence constraints. Precedence diagram, balance delay methods
of line balancing-largest candidate rule, Kilbridge and Westers method, Ranked positional weight method,
Numerical problems covering above methods and computerized line balancing. 4

Unit 4:

Automated Assembly Systems:
Design for automated assembly systems, types of automated assembly system, Parts feeding deviceselements
of parts delivery system-hopper, part feeder, Selectors, feed back, escapement and placement analysis of Multistation Assembly machine analysis of single station assembly. 3

Automated Guided Vehicle System:
Introduction, Vehicle guidance and routing, System management, Quantitative analysis of AGV's with numerical problems and application. 4

Unit 5:

Computerized Manufacturing Planning system :

Introduction, Computer Aided process planning, Retrieval types of process planning , Generative type of process planning, Material requirement planning, Fundamental concepts of MRP inputs to MRP, Capacity planning. 4

Reference Books:

1. **Automation, Production system & Computer Integrated manufacturing,** M. P. Grover" Person India, 2007 2nd edition.
2. **Principles of Computer Integrated Manufacturing,** S. Kant Vajpayee, Prentice Hall India.
3. **Computer Integrated Manufacturing,** J.A.Rehg & Henry.W. Kraebber.

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EAU 015: TOTAL QUALITY MANAGEMENT

Unit 1:

Overview of TQM:
Introduction-Definition, Basic Approach, And Contribution of Gurus – TQM framework, Historical Review, Benefits of TQM, TQM organization. 4

Leadership, Customer Satisfaction and Employee Involvement:
Characteristics of quality leaders, Customers satisfaction, Customer perception of quality, Feedback, Using customers complaints, Employee involvement - Introduction, Teams, Cross functional teams, Quality circles, Suggestion system, Benefits of employee involvement. 4

Unit II:

Human Resource Practices:
Scope of Human Resources Management, leading practices, designing high performance work systemswork and job design, Recruitment and career development, Training and education, Compensation and recognition, Health, safety and employee well-being, performance appraisal. 4

Unit III:

Building and sustaining Total Quality Organizations:
Making the commitment to TQ, Organizational culture and Total Quality, Change management, sustaining the quality organization. 3

Unit IV:

Tools and techniques in TQM:
7 basic tools of quality control, Kaizen, Re-engineering, 6 sigma, Benchmarking, Definition, Process of benchmarking, 5S, Yoke. 2

Unit V:

Quality management systems:
Quality management systems, ISO-9000 series of standards, Overview of ISO-14000, Overview of TS 16959. 3

Quality Function Deployment and Failure Modes Effects Analysis:
Introduction to QFD and QFD process, Quality by design, Rationale for implementation of quality by design, FMEA, Design FMEA and process FMEA. 4

Reference Books:
1. Total Quality Management: Dale H. Besterfield, Publisher - Pearson Education India, ISBN: 8129702606, Edition 03/e Paperback (Special Indian Edition)
2. The management and control of Quality: James R. Evans and William M.Lindsay, ISBN: 981-243-552-0 , Publisher - Thomson South-Western, Edition –6
3. Total Quality Management for Engineers: M. Zairi, ISBN: 1855730243, Publisher: Woodhead

EAU 016: NON DESTRUCTIVE TESTING

L	T	P
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UNIT-1

Introduction to ND testing:

Selection of ND methods, visual inspection, leaks testing, liquid penetration inspection, its advantages and limitations.

Magnetic particle inspection:

Methods of generating magnetic field, types of magnetic particles and suspension liquids – steps in inspection – application and limitation. **(08 Hrs)**

UNIT-II

Eddy current inspection:

Principles, operation variables, procedure, inspection coils, and detectable discounts by the method.

Microwave inspection:

Microwave holography, applications and limitations. 6

UNIT-III

Ultrasonic inspection: Basic equipment characteristics of ultrasonic waves, variables inspection. 4

UNIT-IV

inspection methods pulse echo A, B, C scans transmission, resonance techniques transducer elements, couplets, search units, contact types and immersion types inspection standard-standard reference blocks, inspection of products like casting, extrusions, rolled product, weld set. 4

UNIT-V

Radiography inspection: Principles, radiation source-Rays and gamma rays-rays tubes, radio graphic films, scenes and filters, image intensifiers, techniques charts, industrial radiography, image quality, radiography sensitivity, Peneramotors, electron, neural radiology, application of ICT. Thermal inspection principles, equipment inspection methods applications. 4

UNIT-VI

Optical Holography: Basics of Holography, recording and reconstruction-info metric techniques of inspection, procedures of inspection, typical applications. Acoustical Holography: systems and techniques applications. Indian Standard for NDT. 4

REFERENCE BOOKS:

1. McGonnagle JJ "Non Destructive testing" – Garden and reach New York
2. Non destructive Evolution and quality control" volume 17 of metals hand book 9 edition Asia internal 1989
3. Davis H.E Troxel G.E Wiskovil C.T the Testing instruction of Engineering materials Mc graw hill.

EAU- 017: VEHICLE BODY ENGINEERING AND SAFETY **L T P**

3 1 0

UNIT-I: MATERIALS

Structural materials: Aluminum alloy sheet, extrusion and casting, Austenitic and Ferritic stainless steels, alloy steels. Different types of composites, FRP & metal Matrix Composites. Structural timbers properties designing in GRP and high strength composites different manufacturing techniques of composites. Thermo plastics, ABS and styrenes. Load bearing plastics, semi rigid PUR foams and sandwich panel construction

UNIT-II: ERGONOMICS ANDCONTROLS

Shaping and packaging: Product design and concepts, Aesthetics and industrial design, formal aesthetics and shape, computer aided drafting, surface development, interior ergonomics, ergonomics system design, dashboard instruments, advances in electronic display, CV legal dimension. CV-cab ergonomics, mechanical package layout. Body Fitting and I Controls: Driver's seat, window winding mechanism, Door lock mechanism, other interior mechanisms, driver's visibility' and tests for, visibility, minimum space, requirements and methods or improving space in cars, electric wiring and electronic control systems, advanced body electronics, networking or body systems controls.

UNIT-III: AERODYNAMICSAND FORCE ANALYSIS

Aerodynamics: Basics, aerofoils, aerodynamics drag lift, pitching, yawing and rolling moments, determination of aerodynamic coefficients (wind tunnel testing), racing car aerodynamics, bluff body aerodynamics, local air flows. Load Distribution: Types of load carrying structures -closed, integral, open, flat types. Calculation of loading cases-static,

asymmetric, vertical loads. Load distribution, stress analysis of structure, body shell analysis.

UNIT-IV-. STRUCTURAL DYNAMICS

Noise, Vibration, Harshness: Noise and vibration basics, body structural vibrations, chasis bearing vibration, designing against fatigue, rubber as an isolator. CV body mountings, automatic enclosures, sandwich panels, structure dynamics applied, surety under impact: Impact protection basics, design for crash worthiness, occupant and cargo restraints. Passive

restraint systems, slide impact analysis, bumper system, energy absorbant foams, laws of mechanisms applied 10 safety. Vehicle stability: Steering geometry vehicle and a curvilinear path, and lateral stability, effects of tyre factors, mass distribution and engine location on stability.

UNIT-V: TYPES OFVEHICLES

Vans, trucks and buses: Types of mini coach with trailers, single and double deckers, design criteria based on passenger capacity, goods to be transported and distance to be Covered, constructional details: weights and dimensions, conventional and integral type.

Advanced Transmission Systems Early and later Warner synchronizer, Vauxhall synchronizer- gear materials lubrication ,multistage and polyphase torque converters,coupling-blade angle and fluid flow, converter fluid. **Chevrolet "turbo glide"** transmission ,early and modified Ward-Leonard system

TEXTBOOKS:

1. Body Engineering -Sydney F Page

2. Vehicle body engineering -Giles J Pawlowski,

REFERENCES:

1. Automotive chassis -P.M. Heldt. chilton & Co

2. Handbook on vehicle body design -SAE Publications.

LIST OF ELECTIVE VIII

EAU 020 ENGINEERING SYSTEM DESIGN **L T P**
3 1 0

Unit1:

Introduction:
What is designing, Man as a designer: Design by evolution, inadequacies of traditional design method: System approach of engineering problems: Need models: design history of large scale existing system.

Morphology of Design: The three phases of design projects, the structure of design process, decision making and iteration. 4

UnitII:

Identification And Analysis Of Need:
Preliminary need statement, analysis of need, specifications, and standards of performance and constrains. 2

Origination Of Design Concept:
Process of idealization, mental fixity, and some design methods like morphological analysis, AIDA, brain storming etc. 3

UnitIII:

Preliminary Design:
Mathematical modeling for functional design: concept of sensitivity, compatibility and stability analysis. 3

UnitIV:

Evaluation Of Alternatives And Design Decisions:
Physical realizability, DESIGN TREE: Quality of design, Concept of utility, multi criteria decisions, decisions under uncertainty and risk (Numerical) **08**

UnitV:

Reliability Considerations in Design:
Bath tub curve, exponential reliability function, system reliability concept. (Numerical)

Economics and Optimization in Engineering design:
Economics in Engineering Design, Fixed and variable costs, break-even analysis. (Numerical) 6

REFERENCE BOOKS:
1. An introduction to engineering design method, by V. Gupta and P. Murthy, Tata McGraw Hill.

2000
2. Introduction of Engineering Design by T. Woodson, McGraw Hil1.2001

3. Design & Planning of Engineering systems by D.D. Meredith, K.W. Wong, R.W. Woodhead & K.K. Worthman. 2000
4. Introduction to Design by M.A. Asimov-Prentice Hall. 1996
5. Design Methods - Seeds of Human Futures-Wiley Inter Science. 1970.

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EAU 021: ROBOTICS

Unit 1:

Introduction and Mathematical Representation of Robots
History of Robots, Types of Robots, Notation, Position and Orientation of a Rigid Body, Some Properties of Rotation Matrices, Successive Rotations, Euler Angles For fixed frames X-Y-Z and moving frame ZYZ. Transformation between coordinate system, Homogeneous coordinates, Properties of A T B , Types of Joints: Rotary,Prismatic joint, Cylindrical joint, Spherical joint, Representation of Links using Denvit-Hartenberg Parameters: Link parameters for intermediate, first and last links, Link transformation matrices, Transformation matrices of 3R manipulator, PUMA560 manipulator, SCARA manipulator 8

Unit II:

Kinematics of Serial Manipulators
Direct kinematics of 2R, 3R, RRP, RPR manipulator, puma560 manipulator, SCARA manipulator, Stanford arm, Inverse kinematics of 2R, 3R manipulator, puma560 manipulator.
Unit III:

Velocity and Statics of Manipulators
Differential relationships, jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R, 3R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of 2R maipulators, Statics of serial manipulators, Static force and torque analysis of 3R manipulator, Singularity in force domain. 5

Dynamics of Manipulators
Kinetic energy, Potential energy, Equation of motion using Lagrangian, Equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, Inertia of a link,

Recursive formulation of Dynamics using Newton Euler equation, Equation of motion of 2R manipulator using Lagrangian, Newton-Euler formulation 5

Unit IV:

Trajectory planning
Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning 5

Control
Feedback control of a single link manipulator- first order, second order system, PID control, PID control of multi link manipulator, Force control of manipulator, force control of single mass,Partitioning a task for force and position control- lever, peg in hole Hybrid force and position controller 4

Unit V: Actuators
Types, Characteristics of actuating system: weight, power-to-weightration, operating pressure, stiffness vs. compliance, Use of reduction gears, comparision of hydraulic, electric, pneumatic, actuators, Hydraulic actuators, proportional feedback control, Electric motors: DC motors, Reversible AC motors, Brushles DC motors, Stepper motors- structure and principle of operation, stepper motor speed-torque characteristics **Sensors** Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor- encoders, tachometers, Acceleration sensors, Force and Pressure sensors – piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical , ultrasonic, inductive, capacitive, eddy-current proximity sensors. 5

Reference Books:
1.Fundamental Concepts and analysis, Ghosal A., Robotics, Oxford,2006
2. Introduction to Robotics Analysis, Systems, Applications, Niku, S. B., Pearso Education, 2008
3. Introduction to Robotics: Mechanica and Control, Craig, J. J., 2nd Edition, Addison-Welsey, 1989.
4.Fundamentals of Robotics, Analysis and Control, Schilling R. J., PHI, 2006

EAU 022: TRIBOLOGY **L T P**
3 1 0

Unit –1

Introduction to Tribology:
Properties of oils and equation of flow: Viscosity, Newton's of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, classification of lubricants. 4

Unit-II

Hydrodynamics Lubrication:
Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, idealized full journal bearings. Mechanism of pressure development in an oil film, Reynold's investigations, Reynold's equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems.. 5

Unit-III

Oil flow and thermal equilibrium of journal bearing:
Oil flow through bearings, self-contained journal bearings, bearings lubricated under pressure, thermal equilibrium of journal bearings . 4

Unit IV

Hydrostatic Lubrication
Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing. 4

Unit-V

Bearing Materials
Commonly used bearings materials, properties of typical bearing materials. **Wear:** Classification of wear, wear of polymers, wear of ceramic materials, wear measurements, effect of speed, temperature and pressure. 5

Behavior of tribological components
Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. 4
Tribological measures: Material selection, improved design, surface engineering 2

REFERENEC BOOKS:
1. Basu S K., Sengupta A N., Ahuja B. B.,Fundamentals of Tribiology, PHI 2006
2. Mujumdar B. C., Introduction to Tribiology bearings, Wheelers and company pvt. Ltd 2001.
3. Fuller, D., Theory and Practice of Lubrication for Engineers, New York company 1998
4. Moore, Principles and applications of Tribiology, Pergamaon press 1998
5. Srivastava S., Tribiology in industries, S Chand and Company limited, Delhi 2002

EAU 023: HYDRAULICS AND PNEUMATICS **L T P**
3 1 0

UNIT 1:

Introduction to Hydraulic Power:
Pascal's law and problems on Pascal's Law, continuity equations, introduction to conversion of UNITs. Structure of Hydraulic Control System. **The Source of Hydraulic Power:** Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps. 5

UNIT II:

Hydraulic Actuators and Motors
Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance 4

Control Components in Hydraulic Systems
Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves. 4

UNIT III:

Hydraulic Circuit Design and Analysis
Control of single and Double – acting Hydraulic cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits. 5

Maintenance of Hydraulic systems
Hydraulic oils – Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting . 5

UNIT IV:

Introduction to Pneumatic control
Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. 4

Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod – less cylinders – types, working advantages. Rotary cylinder types construction and application. Design parameters – selection 5

UNIT V:
Directional Control valves
Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve.
Simple Pneumatic Control: Direct and indirect
actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve. 8

Signal processing elements: Use of Logic gates – OR and AND gates pneumatic applications. Practical examples involving the sue of logic gates. Pressure dependent controls types construction –practical applications. Time dependent controls – Principle, construction, practical applications. 4

Reference Books

1. Fluid Power with applications: Anthony Esposito, Fifth edition pearson education, Inc. 2000.
2. Pneumatics and Hydraulics: Andrew Parr. Jaico Publishing Co. 2000.
3. Oil Hydraulic Systems – Principles and Maintenance: S.R. 2002 Majumdar, Tata Mc Graw Hill publishing company Ltd. 2001.
4. Pneumatic systems by S.R.Majumdar, Tata Mc Graw Hill publishing Co., 1995.
5. Industrial Hydraulics: Pippenger, Hicks, McGraw Hill, New York.

EAU 024 ALTERNATIVE ENERGY SOURCES FOR AUTOMOBILES **L T P**
3 1 0

UNIT-1:

Introduction
Types of energy sources, their availability, need of alternative energy sources, Non-conventional energy sources, Classification of alternative fuels and drive trains. Scenario of conventional auto fuels, oil reserves of the world. Fuel quality aspects related to emissions. Technological up gradation required business driving factors for alternative fuels. Implementation barriers for alternative fuels. Stakeholders of alternative fuels, roadmap for alternative fuels. 6

UNIT-II:

Solar energy
Solar energy geometry, solar radiation measurement devices. Solar energy collectors, types of collectors. Direct application of solar energy, solar energy storage system. P.V.effect solar cells and characteristics. Application of solar energy for automobiles. 4

Wind energy
Introduction, principle of wind energy conversion. Types of wind machines, applications of wind energy. Site selection considerations. Advantages and disadvantages of WEC systems. 4

UNIT-III:

Gaseous alternative fuels.
Hydrogen, properties and production of hydrogen. Storage, Advantages and disadvantages of hydrogen. Hydrogen used in SI and CI engines. Hazards and safety systems for hydrogen, hydrogen combustion. Emission from hydrogen. CNG, LNG, ANG, LPG and LFG. 4

UNIT-IV:

Biomass energy
Biogas or Biomethane.History, properties and production of Biogas, classification of biogas plants, biogas storage and dispensing system. Advantages of biogas, hazards and emissions of biogas.Methanol, Ethanol, Butanol, Straight vegetable oil, Biodiesel. 4

Synthetic Alternative fuels
History, properties and production of hythane and HCNG, storage and dispensing of hythane and HCNG. Advantages, disadvantages, fuel kit, combustion process of HCNG and hythane.Emissions ofhythaneandHCNG.DME,DEE,BTL,GTL,CTL,Syngas,producer gas, P-series, Eco-friendly plastic fuel, wood pyrolysis oil, Magnegas,Tyre pyrolysis oil. 5

UNIT-V:
Reformulated conventional fuels
Introduction. Production of coal water slurry.properties, as an engine fuel, emissions of CWS. RFG, Emulsified fuels. Hydrogen-enriched gasoline. Future Alternative Fuels, PMF, Ammonia, Liquid-Nitrogen, Boron, Compressed Air, Water. 4

Introduction to alternative power trains

Components of an EV,.EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs.Hybrid electric vehicles, what is a hybrid EV? HEV drive train components, advantages of HV. History of dual fuel technology, Applications of DFT. Duel fuel engine operation. Advantages and disadvantages of duel fuel technology. 5

REFERENCES

1. S.S.Thipse “Alternative Fuels”. JAICO Publishing House.
2. G.D.Rai “Non-Conventional Energy Sources” Khanna Publishing New Delhi.
3. Alternative fuels for vehicle book by M.poulton
4. Alternative fuels guide book by R. Bechtold.SAE

EAU 030 HYBRID VEHICLES **L T P**
3 1 0

UNIT 1

HYBRID VEHICLES
Performance characteristics of road vehicles, calculation of road load, predicting fuel economy, Grid connected hybrids. 4

PROPULSION METHODS
DC motors-series wound, shunt wound. Compound wound and separately excited motors AC motors - induction, synchronous, brushless DC motor, switched reluctance motors. 4

UNIT II

HYBRID ARCHITECTURE
Series configuration- locomotive drives, series parallel switching, load tracking architecture. Pre transmission parallel and combined configurations-Mild hybrid, power assist, dual mode, power split, power split with shift, Continuously Variable transmission (CVT). Wheel motors. 5

UNIT III

HYBRID POWER PLANT SPECIFICATIONS
Grade and cruise targets. launching and boosting, braking and energy recuperation, drive cycle implications, engine fraction-engine downsizing and range and performance, usage requirements. 4

UNIT IV

SIZING THE DRIVE SYSTEM
Matching electric drive and ICE, sizing the propulsion motor, sizing power electronics 8

UNIT V

ENERGY STORAGE TECHNOLOGY
Battery basics, lead-acid battery, different types of batteries, battery parameters. 8

REFERENCEBOOKS :
1. **The Electric Car: Development & Future of Battery, Hybrid & Fuel-Cell Cars -** Dr Mike Westbrook, M H Westbrook, British library Cataloguing in Publication Data, UK, ISBN0 85296 0131.
2. **Electric and Hybrid Vehicles -** Robin Hardy, Iqbal Husain, CRC Press, ISBN 0-8493-1466-6.
3. Propulsion Systems for Hybrid Vehicles - John M. Miller, Institute of Electrical Engineers,London,ISBN0 863413366.

EAU 031 CONTROL ENGINEERING **L T P**
3 1 0

Unit 1:

Introduction:
Definitions and concept of automatic controls, classification of control system - open and closed loop systems, concepts of feedback, requirements of an ideal control system. 4

Unit II:

Mathematical Modeling:
Transfer function, modeling of mechanical systems, electrical systems, elctromechanical systems, thermal systems, hydraulic and pneumatic systems, and Analogous systems: Force voltage, Force current. 4

Unit III:

Block Diagrams and Signal Flow Graphs:
Block diagram representation, functional block, block diagram reduction, Signal flow graphs, Mason's gain formula. 4

Transient and Steady State Response Analysis:
Introduction, Standard test inputs, concept of time constant and its importance in speed of response, analysis of first order and second order systems, Transient response specifications, System stability analysis – Routh - Hurwitz Criterion. 4

Unit IV:

Frequency Response Analysis using Nyquist Plots:
Polar plots, Nyquist Stability Criterion, Stability Analysis, Relative stability concepts, phase and gain margin, M & N circles. 4

Frequency Response Analysis using Bode Plots:
Bode attenuation diagrams, Stability Analysis using Bode plots, and Simplified Bode Diagrams, phase and gain margin. 4

Unit V:

Control Action and System Compensation:
Types of controllers – Proportional, Integral, Proportional Integral, Proportional Derivative, Proportional Integral Derivative controllers (Basic concept only), Series and feedback compensation, Physical devices for system compensation. 8

References:

1. **Control Engineering**, Uday A. Bakshi and Varsha U. Bakshi, Technical Publications, Pune
2. **Control Engineering**, D. Ganesh Rao and K. Channa Venkatesh, Sanguine Technical Publishers, Bangalore
3. **Feedback and Control Systems**, Joseph J. Distefano, Allen R. Stubberud and Ivan J. Williams, Tata McGraw Hill Publishing Co. Ltd., New Delhi
4. **Modern Control Engineering,** Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., New Delhi
5. **Control Systems Principles and Design,** M. Gopal, Tata McGraw Hill Publishing Co. Ltd., New Delhi
6. **Control Systems Engineering,** I. J. Nagrath and M. Gopal, New Age International publishers, New Delhi

EAU 032 NANO TECHNOLOGY **L T P**
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Unit 1:

An overview of Nanoscience & Nanotechnology
Historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications. 4

Unit II:

Experimental Techniques and Methods
For investigating and manipulating materials in the nano scale – electron microscope – scanning probe microscope – optical and other microscopes – light scattering – x-ray diffraction. 4

Unit III:

Fullerenes
Discovery, synthesis and purification – chemistry of fullerenes in the condensed phase – orientational ordering – pressure effects – conductivity and superconductivity – ferromagnetism – optical properties.

Carbon Nanotubes – synthesis and purification – filling of nanotubes – mechanism of growth – electronic
structure – transport properties – mechanical and physical properties applications. 8

Unit IV:

Self-assembled Monolayers
Monolayers on gold – growth process – phase transitions – patterning monolayers mixed monolayers – applications.

Gas Phase Clusters – history of cluster science – formation and growth – detection and analysis – type and properties of clusters – bonding in clusters. 8

Unit V:

Monolayer-protected Metal Nanoparticles
Method of preparation –characterization – functionalized metal nanoparticles – applications – superlattices. 2

Core-shell Nanoparticles – types – characterization – properties – applications. 2

Nanoshells – types – characterization – properties – applications. 2

Nanobiology – Interaction between biomolecules and nanoparticle surfaces – materials used for synthesis of hybrid nanobio assemblies – biological applications – nanoprobes for analytical applications – nanobiotechnology – future perspectives. 3

Nanomedicines – approach to development – nanotechnology in diagnostic and therapeutic applications. 2

Nanotribology – studying tribology on the nanoscale – applications. 2

References:

1. NANO: The Essentials – Understanding Nanoscience and Nanotechnology; T Pradeep (Professor, IIT Madras); Tata McGraw-Hill India (2007)
2. Nanotechnology: Richard Booker & Earl Boysen; Wiley (2005).
3. Introduction to Nanoscale Science and Technology [Series: Nanostructure Science andTechnology]: Di Ventra, et al (Ed); Springer (2004)
4. Nanotechnology Demystified: Linda Williams & Wade Adams; McGraw-Hill (2007)
5. Introduction to Nanotechnology: Charles P Poole Jr, Frank J Owens, Wiley India Pvt. Ltd., New Delhi, 2007.

EAU 033 MAINTENANCEAND SAFTY ENGINEERING **L T P**
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UNIT -1

Introduction to Maintenance System: Definition, Scope, Objective, functions and Importance of maintenance system, Type of maintenance system, Break down maintenance system. Preventive maintenance, Predictive maintenance, design out maintenance, corrective maintenance, planned maintenance, total productive maintenance, condition monitoring. Problems on selection of methods like preventive or breakdown maintenance, 6

UNIT - II

Economics in Maintenance: Repair, replacement, Repair complexity, Finding out most optimal preventive

maintenance frequency. Numerical treatment required,
Maintenance of Machinery: Causes of machine failure, performance evaluation, complete overhauling of Machines tools. Maintenance planning and scheduling. Repair order control manpower requirement, Maintenance job analysis spare parts control. 6

UNIT - III

Maintenance Planning: Planning of maintenance junctures manpower allocation, long range planning, short range planning. Planning techniques and procedures. Estimation of maintenance work. Maintenance control. 5

UNIT-IV

Computers in maintenance: Features and benefits of Computer aided maintenance. Application of computers to maintenance work. Industrial Safety: Economic importance of accidents, Types of safety organizations, Analysis of accident records, accident investigations, Analysis of accident Safety standards for Mechanical equipment. 6

UNIT- V

Safety standards: Safety standards for Electrical equipment and systems. Chemical hazards, material handling, exhaust systems, welding, Plant house keeping-building, Aisles, passages, floors, tool cribs, washrooms, canteens. 5

REFERENCE BOOKS:
1Maintenance Engineering and Management - R.C.Mishra and K.Pathak, Prentice Hall of India, 2002
2 Maintenance Engineering Hand book - Morrow.
3Hand book of Maintenance Management - Frank Herbaty
4Hand book of Industrial Engg & Management - W. Grant Lreson & Eugene L-Grant
5 Industrial Pollution Control Handbook • LUND *A.* Industrial Maintenance - H P Garg
6 Maintenance Engineering Hand book- Lindrey Higgins, Mc Graw Hill, ffh edition, 2003
7 Plant Engineering Hand book – Staniar

TME-034 MECHANICAL VIBRATION

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UNIT- I

INTRODUCTION: Periodic motion, harmonic motion, superposition of simple harmonic

motions, beats, fourier analysis.Single Degree Freedom System: Free vibration, Natural frequency, Equivalent Systems, Energy method for determining natural frequency, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Damping models – Structural, Coulomb and Viscous damping, Vibrations of system with viscous damping, Logarithmic decrement, Viscous dampers. 8

UNIT- II

Single Degree Freedom: Forced Vibration Forced vibration, Harmonic Excitation with viscous damping, Steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments- Displacement, Velocity, Acceleration and Frequency measuring instrument. 6

UNIT- III

Two Degree Freedom System: Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled System, Undamped dynamic, vibration absorbers, Centrifugal pendulum absorber, Dry friction damper, Untuned viscous damper. 6

UNIT- IV

Multidegree Freedom System: Exact Analysis Undamped free and forced vibrations of multidegree system, Influence numbers, Reciprocal Theorem, Torsional vibration of multi rotor system, Vibration of geared system, Principal coordinates, Continuous systems- Longitudinal vibration of bars, Torsional vibrations of Circular shafts, Lateral vibration of beams. 8

UNIT- V

Multidegree Freedom System: Numerical Analysis Rayleigh's, Dunkerley's, Holzer's and Stodola's methods, Rayleigh – Ritz method. Critical Speed of Shafts: Shafts with one disc with and without damping, Multi-disc shafts, Secondary critical speed. 8

Reference Books :

1. Mechanical Vibration – P. Srinivasan – TMH

2. Mechanical Vibration – G. K. Grover – Jain Bros. Roorkee.

3. Mechanical Vibration –W.T. ThomsonAge Publishers.

4. Mechanical Vibration Practice with Basic Theory – V. Rama Murthy – Narosa Publishers.