U.P. TECHNICAL UNIVERSITY, LUCKNOW

2nd, 3rd and 4th Year
[Effective from session 2009-10]
(With modified course structure of VI & VIII Semester)

B. Tech. Automobile Engineering
U.P. TECHNICAL UNIVERSITY, LUCKNOW
STUDY & EVALUATION SCHEME
B. Tech. Mechanical Engineering / Production Engineering / Industrial & Production Engineering / Mechanical
& Industrial Engineering / Manufacturing Technology / Automobile Engineering / Aeronautical Engineering
[Effective Form session 2009-10]
YEAR II, SEMESTER-III

<table>
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<th>Evaluation Scheme</th>
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**THEORY**

**PRACTICAL/TRAINING/PROJECT**

| 8     | EME - 351   | Material Science & Testing Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 9     | EME - 352   | Machine Drawing-I              | 0 | 0 | 3 | 10 | 10 | 20 | 30 | 50 | 1 |
| 10    | EME - 353   | Thermodynamics Lab*            | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 11    | ECE - 351   | Electrical Machines & Automatic Control lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 12    | GP 501      | General Proficiency            |   |   |   | -  | -  | -  | 50 | -  | 50 | 1 |
|       | Total       |                               | 18 | 5 | 9 | -  | -  | -  | -  | -  | -  | 1000 | 26 |

NOTE: Up to IV semesters – common to Mechanical and related branches (such as Production, Industrial, Manufacturing, Automobile, Aeronautical etc.).

**Paper Code Science Based Open-Electives**

EOE-031/EOE-041 Introduction to Soft Computing (Neural Networks, Fuzzy Logic and Genetic Algorithm)
EOE-032/EOE-042 Nano Sciences
EOE-033/EOE-043 Laser System and Applications
EOE-034/EOE-044 Space Science
EOE-035/EOE-045 Polymer Science & Technology
EOE-036/EOE-046 Nuclear Science
EOE-037/EOE-047 Materials Science
EOE-038/EOE-048 Discrete Mathematics

**Common to Civil Engg. and Mechanical Engg & related branches (as Engineering Core – Interdisciplinary).**

*Human values & Professional Ethics will be offered as a compulsory audit course for which passing marks are 40% in theory & 50% in aggregate. Students will be required to audit it with in the period of their study. There will not carry over facility for this course and the failure student will be required to repeat this course (in next-semester).

**Note:** Mechanical Engineering & related branches students cannot take the Open Elective Course EOE-037/EOE-047: Materials Science.
### U.P. TECHNICAL UNIVERSITY, LUCKNOW

**STUDY & EVALUATION SCHEME**

B. Tech. Mechanical Engineering / Production Engineering / Industrial & Production Engineering / Mechanical & Industrial Engineering / Manufacturing Technology / Automobile Engineering / Aeronautical Engineering

[Effective from Session 2009-10]

**YEAR II, SEMESTER-IV**

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### PRACTICAL/TRAINING/PROJECT

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**Total** | **18** | **5** | **10** | **-** | **-** | **-** | **-** | **1000** | **26** |

**NOTE:** Practical summer training-I of 4-weeks after IV –semester or Minor fabrication project will be evaluated in VII semester

*Industrial Training-I of 4 weeks after IV semester or Minor fabrication project involving work for nearly 4 weeks , which will be evaluated in VII semester*
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**THEORY**

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|      |             |                                   |         |                   |               |        |
|      |             |                                   | 3       | 1                 | 0             | 30     |
|      |             |                                   |         |                   |               |        |
|      |             |                                   | 3       | 1                 | 0             | 30     |
|      |             |                                   |         |                   |               |        |

**PRACTICAL/TRAINING/PROJECT**

|      |             |                                   |         |                   |               |        |
|      |             |                                   | 0       | 0                 | 2             | 10     |
|      |             |                                   |         |                   |               |        |
|      |             |                                   | 0       | 0                 | 2             | 10     |
|      |             |                                   |         |                   |               |        |
|      |             |                                   | 0       | 0                 | 3             | 10     |
|      |             |                                   |         |                   |               |        |
|      |             |                                   | 0       | 0                 | 3             | 10     |
|      |             |                                   |         |                   |               |        |

*Human values & Professional Ethics will be offered as a compulsory audit course for which passing marks are 40% in theory & 50% in aggregate. Students will be required to audit it with in the period of their study. There will not carry over facility for this course and the failure students will be required to repeat the course (in next semester)*
### U.P. TECHNICAL UNIVERSITY, LUCKNOW

**STUDY & EVALUATION SCHEME**

B. Tech. Automobile Engineering  
(Effective from Session 2001-11)  
**YEAR III, SEMESTER-VI**

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### THEORY

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### PRACTICAL/TRAINING/PROJECT

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Industrial Training-II of 4 – 6 weeks after VI semester will be evaluated in VII semester

Note- 4 to 6 Weeks Industrial Training-II after VI semester also to be evaluated in VII semester

*Human values & Professional Ethics will be offered as a compulsory audit course for which passing marks are 40% in theory & 50% in aggregate. Students will be required to audit it within the period of their study. There will not carry over facility for this course and the failure students will be required to repeat the course (in next semester)

**Departmental Electives:**

**Department Elective - I**

1. EAU-011 Automotive chassis and suspension  
2. EAU-012 Tribology  
3. EAU-013 Robotics and Automation

**Department Elective - II**

1. EAU-021 Vehicle transport management  
2. EAU-022 Automotive electrical and autotronics  
3. EAU-023 Product design and assembly automation
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Note: **Practical Training-1 & 2 (4-weeks each) done after 4th & 6th Semesters would be evaluated in 7th semester through report and viva voice etc.

* Project should be initiated in 7th semester beginning, and should be completed by the end of 8th semester with good Report and power-point Presentation etc.

Paper Code
- **EOE-071** Entrepreneurship Development
- **EOE-072** Quality Management
- **EOE-073** Operations Research
- **EOE-074** Introduction to Biotechnology

DEPARTMENTAL ELECTIVES:

**Department Elective - III**
- EAU-031 Vehicle body engineering and safety
- EAU-032 Automotive aerodynamics
- EAU-033 Optimization for engineering design

**Department Elective - IV (Modified)**
- EAU-041 Advanced automobile technologies
- EAU-042 Automotive air conditioning
- EAU-043 Interactive computer graphics
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**THEORY**

**PRACTICAL/TRAINING/PROJECT**

|       | EAU - 802  | Project | 0  | 0  | 12  | -  | 100 | 100 | 250  | 350  | 8           |
| 6     | GP 601     | General Proficiency | -  | -  | -   | -  | -   | -   | -    | 50   | 1           |
| 7     |            |          |     |     |     |     |     |     |      |      |             |
| Total |            |          | 17 | 6  | 10  | -  | -   | -   | -    | 1000 | 24          |

**Paper Code**

**Open Electives – II**

EOE-081 Non Conventional Energy Resources
EOE-082 Nonlinear Dynamic Systems
EOE-083 Product Development
EOE-084 Automation and Robotics

**DEPARTMENTAL ELECTIVES:**

**Department Elective-V**

1. EME-051 Computer aided vehicle design
2. EME-052 Alternative energy sources for automobiles
3. EME-053 Vehicle dynamics

**Department Elective-VI**

1. EME-061 Computer simulation of IC engines
2. EME-062 Finite Element Method
3. EME-063 Hydraulic and pneumatic systems

[7]
EAS-301/EAS-401: MATHEMATICS –III

Unit – I : Function of Complex variable

Analytic function, C-R equations, Cauchy’s integral theorem, Cauchy’s integral formula for derivatives of analytic function, Taylor’s and Laurent’s series, singularities, Residue theorem, Evaluation of real integrals of the type \( \int_{0}^{\infty} f(x) \, dx \) and \( \int_{C} f(z) \, dz \).

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.

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, \( R \), \( p \), \( np \), and \( c \) charts.

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.

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.

Test Books :-


Reference Books :-

ECE-301: FLUID MECHANICS

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

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

III 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.

IV 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.

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

VI Laminar and Turbulent Flow:
Equation of motion for laminar flow through pipes, Stokes’ law, transition from laminar to turbulent low, 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.

VII Boundary Layer Analysis:
Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control, Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect.

References:
1. S Narasimhan : First Course in Fluid Mechanics , University Press
3. M M Das : Fluid Mechanics & Turbomachines , Oxford University Press
4. S.K.Agawal : Fluid Mechanics & Machinery, TMH
8. Fluid Mechanics by Jagdish Lal
Unit-I
- **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.

Unit-II
- **Mechanical properties and Testing**: Stress strain diagram, Ductile & brittle material, Stress vs strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testings such as Strength testings, Hardness testing, Impact testings, Fatigue testing Creep testing, Non-destructive testing (NDT)
- **Microstructural 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.

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

Unit-IV
- **Magnetic properties**: Concept of magnetism - Dia, para, ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages.
- **Super conductivity and its applications**: Messier effect. Type I & II superconductors. High Tc superconductors.

Unit-V
- **Ceramics**: Structure types and properties and applications of ceramics. Mechanical/Electrical behavior and processing of Ceramics.
- **Other materials**: Brief description of other material such as optical and thermal materials concrete, Composite Materials and its uses. Brief introduction to Smartmaterials & Nano-materials and their potential applications
- **Performance of materials in service**: Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control.

References:
2. K.M.Gupta, Materials Science, Umesh Publication.
EME- 302 STRENGTH OF MATERIALS  

UNIT-I

**Compound stress and strains:** Introduction, state of plane stress, Principal stress and strain, Mohr’s stress circle.


UNIT–II

**Stresses in Beams:** Review of pure Bending. Direct and shear stresses in beams due to transverse and axial loads, composite beams.

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

**Torsion:** Review of Torsion, combined bending & torsion of solid & hollow shafts.

UNIT-III

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

**Columns and Struts:** Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler’s theory and experimental results, Ranking Gardon Formulae, Examples of columns in mechanical equipments and machines.

UNIT-IV

**Thin cylinders & spheres:** Hoop and axial stresses and strain. Volumetric strain.

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

UNIT-V

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

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

Books :
1. Mechanics of Materials by Pytel
2. Strength of Materials by Ryder
3. Strength of Materials by Timoshenko and & Youngs
4. Mechanics of Materials by Bear Jhonson
Unit – I:


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

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.

Unit – II:

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.

Unit – III

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.

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

Unit – IV

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

Introduction to working of IC engines: Compression Ignition engines, Spark Ignition engines, 2 stroke and 4 stroke engines, Performance parameters of IC engine, Heat balance sheet.

Books:
1. Engineering Thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
2. Fundamentals of Thermodynamics by Sonntag, Wiley India Pvt. Ltd.
4. Thermodynamics by J.P. Holman, McGraw Hill.

EME- 351: MATERIALS SCIENCE AND TESTING Labs

L T P
0 0 3

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

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 C.I., 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.
10. Suitable experiment on Magnetic/ Electrical/Electronic materials.

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

1. Strength testing of a given mild steel specimen on UTM with full details and s-e plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact testing on impact testing machine like Charpy, Izod or both.
5. Spring index testing on spring testing machine.
6. Fatigue testing on fatigue testing machine.
7. Creep testing on creep testing machine.
8. Deflection of beam experiment, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young’s modulus of beam.
9. Torsion testing of a rod on torsion testing machine.
10. Study of non-destructive testing methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

EME – 352: MACHINE DRAWING-I LAB

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Introduction (1 drawing sheet)
Graphics Language, Classification of drawings, Principles of drawing, IS codes for machine drawing, scales, types of lines, section lines, Dimensioning

Orthographic Projections (1 drawing sheet)
Principle of first angle and third angle projection, drawing of machine elements in first angle projection, selection of views, sectional views

Screwed fasteners (2 drawing sheet)
Thread nomenclature, Forms of thread, Thread series, designation, Representation of threads, Bolted joints, Locking arrangement of nuts

Keys and Cotters and Pin joint (1 drawing sheet)
Types of keys, Cotter joint or Knuckle joint

Shaft Couplings (1 drawing sheet)
Introduction, Rigid coupling or Flexible coupling

Riveted joints (1 drawing sheet)
Introduction, rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint

Assembly Drawing (1 drawing sheet)
Introduction, Engine parts-stuffing box, cross head
Free hand sketching*
Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.
* students may be asked to submit the free hand sketching assignment at the end of the semester

Books and References:
4. Engineering drawing Practice for School and Colleges, SP46-1988 (BIS)

EME-353 : THERMODYNAMICS LAB

Experiments : Minimum 10 experiments out of following:

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

ECE-351 : Fluid Mechanics Lab

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 coefficient 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.

EEE – 409 : ELECTRICAL MACHINES & AUTOMATIC CONTROL

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

**Three phase Induction Motor**: Construction, equivalent circuit, torque equation and torque-slip characteristics, speed control.  

**Alternator**: Construction, e.m.f. equation, Voltage regulation and its determination by synchronous impedance method.  

**Synchronous Motor**: Starting, effect of excitation on line current (V-curves), synchronous condenser.  

**Servo Motor**: Two phase a.c. servo motor & its application.

UNIT III:

**Modeling of Mechanical System**: linear mechanical elements, force-voltage and force current analogy, electrical analog of simple mechanical systems; concept of transfer function & its determination for simple systems.  

**Control System**: Open loop & closed loop controls, servo mechanisms; concept of various types of system.  

**Signals**: Unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics.

UNIT IV:

**Time Response Analysis**: Time response of a standard second order system and response specifications, steady state errors and error constants.  

**Stability**: Concept and types of stability, Routh Hurwitz Criterion and its application for determination of stability, limitations; Polar plot, Nyquist stability Criterion and assessment of stability.

UNIT V:

**Root Locus Techniques**: Concept of root locus, construction of root loci.  

**Frequency Response Analysis**: Correlation between time and frequency responses of a second order system; Bode plot, gain margin and phase margin and their determination from Bode and Polar plots.  

**Process control**: Introduction to P,PI and PID controllers their characteristics, representation and applications.

Text Book:

3. K. Ogata, “Modern Control Engineering” Prentice Hall of India.  
4. B.C. Kuo, “Automatic Control systems.” Wiley India Ltd.

Reference Books:

5. Irvin L. Kosow, “Electric Machinery and Transformers” Prentice Hall of India.  
6. D. Roy Choudhary, “Modern Control Engineering” Prentice Hall of India.  

EME-401 APPLIED THERMODYNAMICS  

Unit-I  

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


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

**Condenser:** Classification of condenser, Air leakage, Condenser performance parameters

**Unit-III**

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

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

**Unit-IV**

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

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

**Unit-V**

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

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

**Books:**
3. Thermal Engg. By P.L. Ballaney, Khanna Publisher
4. Theory of Stream Turbine by W.J. Kearton
5. Steam & Gas Turbine by R.Yadav, CPH Allahabad
8. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Wesley Long man

**EME- 402 : MANUFACTURING SCIENCE-I**

**Unit-I**

**Introduction :**

**Metal Forming Processes :**
Elastic & plastic deformation, yield criteria. Hot working vs cold working. Analysis (equilibrium equation method) of Forging process for load estimation with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging
Unit-II
**Metal Forming Processes (continued):** Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application. 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:**

Unit-V
**Casting (Foundry)**
Die Casting, Centrifugal casting. Investment casting, CO2 casting and Stir casting etc. 3

Books:
1. Manufacturing Science by Ghosh and Mallik
3. Production Technology by R.K. Jain
4. Manufacturing Technology by P.N. Rao., TMH
5. Materials and Manufacturing by Paul Degarmo.

**EME -403 : MEASUREMENT AND METROLOGY**

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**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. 2
Signal Display & Recording Devices 1

Unit-II
Time related measurements:
- Counters, stroboscope, frequency measurement by direct comparison. 1
- Measurement of displacement 1

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
Metrology and Inspection:
- Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardisation. 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. 2
- Tool makers microscope, profile project autocollimator. 1
- Interferometry: principle and use of interferometry, optical flat. 2
- Measurement of screw threads and gears. 1
- Surface texture: quantitative evaluation of surface roughness and its measurement. 1

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

References

EME – 451 : MACHINE DRAWING-II LAB

Review of Orthographic Projections (1 drawing sheet)
Orthographic Projection of solids in First angle of projection, missing lines views, interpretation of views 2

Part and Assembly Drawing (2 drawing sheet)
Assembly drawing of eccentric, lathe tail stock, air valve, screw jack, connecting rod, safety valve etc. 2

Specification of Materials (1 drawing sheet)
Engineering materials, representation. Code designation of steel, copper, aluminium etc. 1

Limits, Tolerance and Fits (1 drawing sheet)
Limit system, Tolerances, Method of placing limit dimensions, Fits-types 2

Surface Roughness (1 drawing sheet)
Introduction, nomenclature, machining symbols, indication of surface roughness 1

Production Drawing (1 drawing sheet)
Types, Examples of simple machine elements like helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc.  

**Computer Aided Drafting** (2 drawings)  
Introduction, input, output devices, introduction to software like AutoCAD, ProE, basic commands and development of 2D and 3D drawings of simple parts

**Books and References:**  
4. Engineering Drawing - RK Dhawan - S. Chand  
5. AutoCAD-S. Vshal - Dhanpat Rai  

**EME-452 : MANUFACTURING SCIENCE-1 LAB**  
0 0 3

**Experiments :**  
Say minimum 8 experiments out of following (or such 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.  
13. Powder metallurgy experiment.  
15. Any other suitable experiment on manufacturing science / process / technique.

**EME 453: MEASUREMENT & METROLOGY LAB**  
0 0 2

**Experiments:** Minimum 8 out of following (or such experiments)  
1. Study & working of simple measuring instruments- Vernier calipers, micrometer, tachometer.  
4. Study & angular measurement using level protector  
5. Adjustment of spark plug gap using feeler gauges.  
7. Use of dial indicator to check a shape run use.  
8. Study and understanding of limits, fits & tolerances  
9. Study of Pressure & Temperature measuring equipment.  
10. Strain gauge measurement.  
11. Speed measurement using stroboscope.  
12. Flow measurement experiment

[19]
14. Experiment on Dynamometers.

EEE – 459 : ELECTRICAL MACHINES & AUTOMATIC CONTROL LAB

Note: To perform at least 7 experiments of Electrical Machines and 3 experiments of Automatic Control System

A. Electrical Machines
1. To obtain speed-torque characteristics and efficiency of a dc shunt motor by direct loading.
2. To obtain efficiency of a dc shunt machine by no load test.
3. To obtain speed control of dc shunt motor using (a) armature voltage control (b) field control.
4. To determine polarity and voltage ratio of single phase and three phase transformers.
5. To obtain efficiency and voltage regulation by performing O.C. and S.C. tests on a single phase transformer at full load and 0.8 p.f. loading.
6. To obtain 3-phase to 2-phase conversion using Scott connection.
7. To perform load test on a 3-phase induction motor and determine (a) speed- torque characteristics (ii) power factor v/s line current characteristics.
8. To study speed control of a 3-phase induction motor using (a) Voltage Control (b) Constant (Voltage/ frequency) control.
9. To perform open circuit and short circuit test on a 3-phase synchronous machine and determine voltage regulation at full load and unity, 0.8 lagging and 0.8 leading power factor using synchronous impedance method.
10. To determine V-curve of a 3-phase synchronous motor at no load, half load and full load.

B. Automatic Control System:

1. To determine transient response of a second order system for step input for various values of constant ‘K’ using linear simulator unit and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To determine speed – torque characteristics of an a.c. 2-phase servo motor.
4. To study and calibrate temperature using Resistance Temperature Detector (RTD)
5. To study dc servo position control system within P and PI configurations.
6. To study synchro transmitter and receiver system and determine output V/s input characteristics.
7. To study open loop and closed loop control of a dc separately excited motor.

EME-501 : MACHINE DESIGN-I

UNIT I
Introduction
Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads

UNIT II
Design against Static Load
Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure

[20]
Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria

**Riveted Joints** - Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint

**UNIT III**

**Shafts**
Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity

**Keys and Couplings**
Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings- Design of rigid and flexible couplings

**UNIT IV**

**Mechanical Springs**
Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading

**Power Screws**
Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack

**Note:** Design data book is allowed in the examination

**Books and References:**
3. Machine design-M.F. Spott, Prentice Hall India

**EAU 501 : THEORY OF MACHINES**

**Objective:** To expose students to different mechanisms, their methods of working, forces involved. & their balancing.

**Unit I**

**Introduction:**
Mechanism and machines, Kinematic links, Kinematic pairs, Kinematic chains, plane and space mechanism. kinematic inversion, equivalent linkages, four link planer & slider crank mechanisms, mobility and range of movement, straight line mechanisms, steering mechanisms, pantograph, problems.

**Unit II**

**Kinematic Analysis or Plane Mechanisms**
Displacement analysis, general plane motion, instantaneous center of velocity, graphical and analytical methods of velocity and acceleration analysis, problems.

**Unit III**

**Gearing & Cams**
Fundamental law of gearing, involute spur gears, characteristics of involute action, Interference and undercutting, center distance variation, non standard gear teeth, helical, spiral, bevel and worm gears, problems. Types of cams - Design profiles-knife edged, flat faced & roller ended followers with & without offsets for various types of follower motions, problems.

**Unit IV**

**Static and Dynamic Force Analysis**
Static force analysis of planer mechanisms, dynamic force analysis including inertia and frictional forces of planer mechanisms.

Unit V
Dynamics of Reciprocating Engines
Engine types, indicator diagrams, gas forces equivalent masses, inertia forces, bearing loads in a single cylinder engine, crankshaft torque, engine shaking forces.

Unit VI
Balancing of Rotating Components
Static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of rotors, balancing machines, field balancing.

Unit VII
Balancing of Reciprocating Parts
Balancing of single cylinder engine, balancing of multi cylinder-inline, radial and V type engines, firing orders.

Unit VIII
Gyroscope
Gyrosopes, gyroscopic forces and couples, gyroscopic stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

Text Books

Ref. Books
3. Theory of machines by Abdulla Sharif

EME-503 : MANUFACTURING SCIENCE-II
L T P
3 1 0

Unit-I
A Metal Cutting and Machine Tools

Metal Cutting-

Unit-II
Machine Tools
(i) Lathe : Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout.
(ii) Shaper, slotter, planer : Construction, operations & drives.

Unit-III
Grinding & Super finishing
Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding. 

(vi) Super finishing: Honing, lapping, polishing.

**Standardization & Interchangeability, Limits, Fits & Tolerance and Surfaceroughness**: 
Introduction to Standardization & Interchangeability Limits, Fits, Tolerances and IS standards, Limit-gauges, and surfaceroughness.

**Unit-IV**

**B. Metal Joining (Welding)**
Thermodynamic and Metallurgical aspects in welding and weld. Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ.

**Unit-V**

**C. Introduction to Un-conventional Machining and Welding**
Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding.

**Books**
1. Manufacturing science by Ghosh and Mallik
2. Fundamentals of Metal Cutting and Machine tools by Boothroyd
3. Production Technology by R.K. Jain
4. Production Technology - H.M.T.
5. Production Engineering Science by P.C. Pandey
6. Modern Machining Processes by P.C. Pandey & H.S. Shan
7. Manufacturing science by Degarmo
10. Advanced Machining Process - VK Jain

**EME-504 HEAT & MASS TRANSFER**

<table>
<thead>
<tr>
<th>UNIT-1</th>
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<tbody>
<tr>
<td><strong>Introduction to Heat Transfer:</strong></td>
<td><strong>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.</strong></td>
<td><strong>2</strong></td>
<td><strong>3 1 0</strong></td>
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<tr>
<td><strong>Conduction:</strong></td>
<td>One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions.</td>
<td><strong>3</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Steady State one-dimensional Heat conduction:</strong></td>
<td>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.</td>
<td><strong>3</strong></td>
<td></td>
</tr>
<tr>
<td><strong>UNIT-2</strong></td>
<td><strong>Fins:</strong></td>
<td>Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells.</td>
<td><strong>3</strong></td>
</tr>
<tr>
<td><strong>Transient Conduction:</strong></td>
<td>Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts.</td>
<td><strong>4</strong></td>
<td></td>
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</tbody>
</table>
UNIT-3
Forced Convection:
Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed 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.

Natural Convection:
Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere; Combined free and forced convection.

UNIT-4
Thermal Radiation:
Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck’s law, Wein’s displacement law, Stefan Boltzmann law, Kirchoff’s law; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.

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.

Condensation And Boiling:
Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling.

Introduction To Mass Transfer:
Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.

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

Unit–2
SI Engines:
Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines. 2
Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI. 3
Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition. 2

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

Unit–4
Engine Cooling: Different cooling systems, Radiators and cooling fans. 1
Lubrication: Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. 2
Supercharging: Effect of altitude on power output, Types of supercharging 1

Compressors:
Classification, Reciprocating compressors, Single and Multi stage compressors, Intercooling, Volumetric efficiency. 2
Rotary compressors, Classification, Centrifugal compressor, Axial compressors, Surging and stalling, Roots blower, Vaned compressor. 2

BOOKS:
2. IC Engines, by Rogowsky, International Book Co.
4. IC Engine Analysis & Practice by E.F. Obert.
6. IC Engine, by R. Yadav, Central Publishing House, Allahabad
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia

EME-551 : MACHINE DESIGN-I Lab

L T P
0 0 2

Note: Eight experiments out of the following are to be performed. Students are advised to use design data book for the design. Drawing shall be made wherever necessary on small drawing sheets
1. Design & drawing of Cotter joint.
2. Design & drawing of Knuckle joint
3. Design of machine components subjected to combined steady and variable loads
4. Design of eccentrically loaded riveted joint
5. Design of boiler riveted joint
6. Design of shaft for combined constant twisting and bending loads
7. Design of shaft subjected to fluctuating loads
8. Design and drawing of flanged type rigid coupling
9. Design and drawing of flexible coupling
10. Design and drawing of helical spring
11. Design and drawing of screw jack
EAU 551 THEORY OF MACHINES LAB

List of Experiments
1. To study various types of Kinematic Links, pairs, chains and Mechanisms.
2. To study inversions of 4 Bar mechanisms. Single and double slider crank mechanisms.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. Create various types of linkages mechanism in CAD and simulate for motion outputs and study the relevant effects.
5. To generate spur gear involute tooth profile using simulated gear shaping process.
6. To study various types of gear - Helical, cross helical worm, bevel gear.
7. To study various types of gear trains -simple, compound, reverted, epicyclic and differential.
8. Determine the moment of inertia of connecting rod by compound pendulum method and tri-filer suspension pendulum.
9. To perform the experiment for static balancing on static balancing machine.
10. To perform the experiment for dynamic balancing on dynamic balancing machine.
11. To study the effect of unbalance of rotating mass on hard bearing balancing machine.
12. To study gyroscopic effects through models.

Note:
1. At least ten experiments are to be performed in the semester.
2. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.

EME-553 : MANUFACTURING SCIENCE -II – LAB

Say, min 8 experiments out of the following
(or such experiment along-with study of the machines/processes)
1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine.
3. Tool grinding (to provide tool angles) on tool-grinder machine.
5. Machining a block on shaper machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses.
15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG Welding.
18. Macro and Microstructure of welding joints, HAZ.
EME-554 : HEAT & MASS TRANSFER – LAB

Minimum 10 experiment of the following
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.
8. Any experiment on Stefan's Law, on radiation determination of emissivity, etc.
9. Any experiment on solar collector, etc.
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable experiment on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.

EAU 602 AUTO FUELS AND LUBRICANTS

OBJECTIVE:
At the end of the course, the students are expected to acquire knowledge about the properties of fuels and lubricants for the design and operation of the I.C. engines.

UNIT I
MANUFACTURE OF FUELS AND LUBRICANTS
Structure of petroleum refining process, classification of petroleum fuels, thermal cracking, catalytic cracking, polymerization, alkylation isomerisation, blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants.

UNIT II
PROPERTIES & TESTING OF FUELS
Thermo-chemistry of fuels, properties and testing of fuels & Lubricants, relative density, calorific value, fire point, distillation, vapor pressure, flash point, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index. API gravity, aniline point Viscosity index etc.

UNIT III
FUEL RATING & ADDITIVES
Cetane rating, fuel requirements. Additive mechanism, requirements of an additive, petrol fuel additives and diesel fuel additives - specifications of fuels.

UNIT IV
COMBUSTION
SI Engine - name propagation and mechanism of combustion, normal combustion, knocking, octave, rating. Fuel requirements. CI engine, mechanism of combustion, diesel knock.

UNIT V
ALTERNATE FUELS
Use of alternate fuel in engines- LPG. CNG need for alternate fuels, availability & their properties, general use of alcohols. LPG. CNG. LNG, hydrogen, ammonia, vegetable oils, bio-diesel & biogas. merits &
demerits of alternate fuels. Introduction to alternate energy sources like, electric vehicle, hybrid, fuel cell & solar cars.

UNIT IV
LUBRICANTS
Classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease- classification, properties, test. Specific requirements for automotive lubricants, oxidation, deterioration and degradation of lubricants, additives, synthetic lubricants.

UNIT VII
THEORY OF LUBRICANTS
Engine friction - introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system.

TEXT BOOKS

REFERENCE BOOKS
5. Energy today & tomorrow by Maheswar Dayal, I & B Horishr India.

EAU603 DESIGN OF AUTOMOTIVE COMPONENTS

UNIT-1
CLUTCH DESIGN CALCULATION
Design of single plate clutch, multi plate clutch, design of centrifugal clutch, cone clutch, energy dissipated, torque capacity of clutch, design of clutch components, design details of roller and sprag type of clutches.

UNIT-II
GEAR BOX
Performance of vehicle, total resistance to motion, traction and tractive effort, acceleration, calculation of gear ratio, design of three speed gear box, design of four speed gear boxes.

UNIT – III
VEHICLE FRAME AND SUSPENSION
Study of loads, moments and stresses on frame members, computer aided design of frame for passenger and commercial vehicles, computer aided design of leaf springs, coil springs and torsion bar springs.

UNIT – IV
FRONT AXLE AND STEERING SYSTEMS
Analysis of loads, moments and stresses at different sections of front axle, determination of loads at kingpin bearings, wheel spindle bearings, choice of bearings, determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

UNIT - V FINAL DRIVE AND REAR AXLE
Design of propeller shaft, design details of final drive gearing, design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings.

TEXT BOOKS
REFERENCES

EAU-653 : MACHINE DESIGN-II Lab

A. Computer and Language : students are required to learn the basics of computer language such as C and C++ so that they should be able to write the computer programme (3practical turns)

B. Writing Computer programme for conventional design: Students are required to write computer program and validate it for the design of machine components done in theory subject (5practical turns)

C. Mini Project: Each student will be given a real life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester.

EAU 652 FUELS AND LUBRICANTION LAB

EXPERIMENTS
1. Temperature dependence of viscosity of lubrication oil by Redwood Viscometer.
2. Viscosity Index of lubricating oil by Saybott Viscometer.
4. Flash and Fire points of lubricants.
5. Drop point of grease and mechanical penetration in grease.
7. Calorific value of gaseous fuel
8. Study of semi solid lubrication in various Automobile Unit & Joints
9. Study of lubrication in transmission, final drive, steering gearbox.
10. Study of analytical equipment for oil analysis.
11. To find out volatility characteristic of different fuels by ASTM distillation methods (diesel, gasoline-lubricants).

Note: At least ten experiments are to be performed during the semester.

EAU 651 1C ENGINE AND AUTOMOBILE LAB

EXPERIMENTS
1. To study constructional details and prepare layouts of front engine/rear engine dive lines.
2. Performance of CI and SI engine
3. Impact of Variable compression ratio on Performance
4. To study constructional details and prepare layout of four wheel drive line
5. To study construction of single plate and multi plate clutches and draw sketches.
6. To study construction of diaphragm type clutch and draw sketches.
7. To study and prepare layouts of sliding mesh and constant mesh gear boxes.
8. To study construction of front & rear suspension systems and draw sketches.
9. To study construction of steering system for manual/power arrangement and draw sketches.
10. To study construction of hydraulic braking (disc/drum) systems and functioning of master & wheel cylinders and draw sketches.
11. To study construction of different types of Automobile Wheels and Tyres & draw sketches.
12. To study constructional details and prepare layout of different types of Cooling systems.
13. To study construction of power assisted braking systems and draw sketches.
14. To study & prepare layout of Lubrication System in Automobiles.

Note: At least ten experiments are to be performed in the semester.
UNIT-I
Computers in industrial Manufacturing: Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices.

UNIT-II
Computer Graphics: Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

UNIT-III
Geometric modeling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

UNIT-IV
Drafting and Modeling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling.

UNIT-V

UNIT-VI
Group Tech: Part family, coding and classification, production now analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

UNIT-VII
Computer aided Quality Control: Terminology in quality control, the computer in ac, contact inspection methods, noncontact inspection methods-optical, noncontact inspection methods-nonoptical, computer aided testing, integration of CAQC with CAD/CAM.

UNIT-VIII
Computer integrated manufacturing systems: Types of Manufacturing systems, Machine tools and related equipment, material handling systems, computer control systems, human labor in the manufacturing systems, CIMS benefits.

TEXT BOOKS:
1. CAD / CAM A Zimmers & P. Groover/PEIPHI
2. CAD/CAM Theory and Practice/Ibrahim Zeid/TMH

REFERENCES:
1. Automation, Production systems & Computer integrated Manufacturing! Groover/P.E
2. CAD/CAM/CIM/Radhakrishnan and Subramanian/New Age
3. Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson
4. CAD/CAM: Concepts and Applications/Avalala PHI

UNIT-1
Introduction: Pollutants-sources-formation-effects-transient operational effects on pollution.

UNIT- II
SI engine Combustion and Pollutant Formation: Chemistry of SI engine Combustion, HC and CO formation in 4 stroke and 2 stroke SI engines, NO formation in SI Engines, Effect of operating variables on emission formation.

UNIT- III
CI engine Combustion and Emissions: Basic of diesel combustion-Smoke emission in diesel engines- Particulate emission in diesel engines. Color and aldehyde emissions from diesel engines, Effect of operating variables on emission formation.

UNIT –IV
Control Techniques for SI and CI: Design changes, optimization of operating factors, exhaust gas re-circulation, fumigation, air injector PCV system-Exhaust treatment in SI engines-Thermal reactors-Catalytic converters, Catalysts, Use of unleaded petrol.

UNIT –V

Reference:
1. Mathur M. L., Internal Combustion Engines

EAU 751 CAD/CAM Lab

L T P

1. Drafting : Development of part drawings for various components in the form of orthographic and isometric. Representation of Dimensioning and tolerances scanning and plotting. Study of script, DXF AND IGES FILES.
3. a. Determination of deflection and stresses in 2D and 3D trusses and beams.
   b. Determination deflections component and principal and Von-mises stresses in plane stresses in plane stress, plane strain and Axisymmetric components.
   c. Determination of stresses in 3D and shell structures (at least one example in each case) d. Estimation of natural frequencies and mode shapes. Harmonic response of 20 beam. e. Study state heat transfer Analysis of plane and Axisymmetric components.
4. a) Development of process sheets for various components based on tooling Machines.
   b) Development of manufacturing detects and tool management systems.
   c) Study of various post processors used in NC Machines.
   d) Development of NC code for free from and sculptured surfaces using CAM packages.
   f) Quality Control and inspection.

Packages: Use of Auto CAD, Micro Station, CATIA, Pro-E, 1-DEAS, ANSYS. NISA, CAEFEM, ibbs CAM, Master CAM etc,
1. Study of Pressure pickups, charge amplifier, storage oscilloscope and signal analysers used for 1C engine testing.
2. Performance study of petrol and diesel engines both at full load and part load conditions.
3. Morse test on petrol and diesel engines.
4. Determination of compression ratio, volumetric efficiency and optimum cooling water flow rate in engines.
5. Heat balance test on an automotive engine.
6. Testing of 2 and 4 wheelers using chassis dynamometers.
7. Study of NDIR Gas Analyser and FID
8. Study of Chemiluminescent NOx analyzer
9. Measurement of HC, CO, CO2,02 using exhaust gas analyzer
10. Diesel smoke measurement

References:

EAU 801 : Trouble shooting, Servicing & Maintenance of Automobile

UNIT I

UNIT II
Engine Maintenance : Dismantling of engine components, cleaning methods, visual inspection and dimensional check of various engine components, minor and major tune up, reconditioning and repairing methods of engine components. Assembly procedure, special tools used for maintenance, repair and overhauling. Cooling Systems-Anti corrosion and antifreeze solutions, radiator, and thermostat. Lubrication oil topping up, oil change, oil relief valve; fuel feed systems, FIP adjustment and testing, injector testing.

UNIT III
Chassis and drive line maintenance: Mechanical automotive type gear box- mechanical automatic types. Final reduction, propeller shaft, front and rear suspension systems, brake systems-hydraulic, servo, air. Air bleeding, steering system, axles, wheel alignment-tires.

UNIT IV
Electric system maintenance : Battery testing method, starter motor, charging system - a DC generator, AC alternator, regulator, ignition system- coil ignition, transistor assisted ignition, capacitor discharge ignition. Electric horn, wiper motor, flasher, electric fuel pump, gauges. Lighting system- head lights focusing. Wiring harness testing.

UNIT V
Body repair : Minor body panel beating, tinkering, shouldering. Painting : Introduction of automotive paints, types of paints, corrosion and anticorrosion method, rubbing polishing, working of paint booth, door lock mechanism, window glass actuation mechanism.

TEXTBOOK
DETAILS OF DEPARTMENTAL ELECTIVES
ELECTIVE-1  
EAU-011 : AUTOMOTIVE CHASSIS AND SUSPENSION  

Unit-1
Introduction: Types of chassis, chassis layout, vehicle body, chassis lubrication, four wheel drive, transfer box rear engine vehicles. Materials of chassis and body. Vibration dampers.
Propeller shaft & universal joints: torque tube & Hotchkiss drive, hook's types universal joint, shaft whirling, C.V. joint, divided propeller shaft, rubber universal coupling, slip joint.

Unit-2
Steering System: types of steering system, Ackermann principle, davis steering gears, system components, steering gear boxes. Rack and pinion steering gear, types of steering linkages, power steering wheel geometry, caster, camber, toe-in, toe-out, wheel alignment, balancing
Brakes: types of brake, mechanical, hydraulic, pneumatic brakes, disc and drum brakes, self energizing brakes, engine brakes, brake system components, valves, caliper, and brake shoes.

Unit-3
Suspension: purpose, front and rear suspension, two & 4 wheel independent suspension. Suspension system components, leaf springs, coil springs, dampers, torsion bars. MacPhreson strut, stabilizer bars, arms etc. air suspension system. Types of front and rear suspension system.
Wheel & tyres: Types of wheels, construction, wired wheels, tyres, construction, types, radial, bias & belted bias, comparison, slip angle, under and over steering, tread patterns, tyre re-treading cold and hot, tyre specification tubeless tyre.

Unit-4
Transmission requirements: Requirements of transmission system, general arrangements for power transmission for front engine, rear engine vehicle, four wheel drive vehicle, dead axle and axle less transmission.
Clutch: Single plate, multi plate clutch, centrifugal clutch, electromagnetic clutch, constructional details, torque capacity and clutch friction materials.
Gear Box: Requirements of gear box, sliding mesh gear box, constant mesh gear box synchromesh gear box, epicyclic gear box, velocity ratio and gear ratio for vehicle, performance characteristics in different speed, overdrive.

Unit-5
Fluid Coupling: principle of operation, constructional details, torque capacity and performance curve.
Torque converter: principle of operation, constructional details, torque capacity and performance curve. Multistage torque converter, converter fluid.
Hydrostatic drive: Various types of hydrostatic system, working principle of hydrostatic system, advantage and limitations, Jenny hydrostatic drive, comparison of hydrostatic and hydrodynamic drive.

Electric drive: Principle of electric drive, Early ward leonard control system, Modify Leonard control system, advantage of electric drive, limitation of electric drive.


Text Book
2. Automobile engineering" K.M. Gupta.

EAU 012 TRIBOLOGY

UNIT-I
Study of various parameters: Viscosity, flow of fluids, viscosity and its variation-absolute and kinematic viscosity, temperature variation, viscosity Index determination of viscosity, different viscometers used. Hydrostatic lubrication: Hydrostatic step bearings, applications to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearings.

UNIT II
Hydrodynamic theory of lubrication: Various theories of lubrication, Petroff's equation, Reynolds equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydrodynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti-friction bearing.

UNIT-III
Friction and power losses in journal bearings: Calibration of friction loss friction in concentric bearings, bearing modulus, Sonraerfield number, heat balance, practical consideration of journal bearing design considerations.

UNIT-IV

UNIT-V
Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings.
Bearing materials: General requirements of bearing materials, types of bearing materials.

TEXT BOOKS:
1. Fundamentals of Tribotogy, Basu, SenGupta and Ahuja, PHI
2. Tribotogy in Industry: Sushil Kumar Srivatsava, S. Chand &Co.
REFERENCE:
1. Tribology - B.C. Majumdar
UNIT - I: BASIC CONCEPTS
Automation and Robotics - An overview of Robotics - present and future applications - classification by coordinate system and control system, Dynamic stabilization of Robotics.

UNIT - II: POWER SOURCES AND SENSORS
Hydraulic, Pneumatic and electric drivers - Determination HP of motor and gearing ratio, variable speed arrangements, Path Determination - Machinery Vision - Ranging - Laser - Acoustic, Magnetic Fiber Optic and Tactile Sensor

UNIT - III: MANIPULATORS, ACTUATORS AND GRIPPERS

UNIT - IV: KINEMATICS
Differential transformation and manipulators, Jacobians - problems. Dynamics: Lagrange - Euler and Newton - Euler formulations - Problems.
Forward and Inverse Kinematic Problems, Solutions of Inverse Kinematic problems, Multiple Solution, Jacobian Work Envelop - Hill Climbing Techniques.

UNIT - V: PATH PLANNING
Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion - straight line motion - Robot programming, languages and software packages.

CASE STUDY
Multiple Robots - Machine Interface - Robots in Manufacturing and Non-Manufacturing applications - Robot Cell Design Selection of a Robot

TEXTBOOKS:
1. Industrial Robotics / Groover M P / Pearson Edu.

REFERENCES:
2. Robotics and Control / Mittal R K & Nagrath IJ / TMH.
Department Elective-II

EAU 021 VEHICLE TRANSPORT MANAGEMENT  

UNIT-I  
Historical Background: Introduction, the growth of a network, trams, trolley buses, private car's subsidies.  
The Infrastructure: Road- Approach Road. Highways National, State, District, traffic condition, relief of  
layout of premises, equipment, use of machinery, conveyance of staff, facilities for passengers. Maintenance  
-preventive, breakdown, overhauling -major, minor.

UNIT-II  
Organisation and Management: Forms of ownership, principle of transport, management -internal  
organisation, centralised condition, decentralised condition (Engineering, traffic and administration),  
staff administration: industrial relation, administration, recruitment and training, welfare, health and safety.  
Public relations divisions: Dissemination of information, maintaining goodwill- handling complaints,  
traffic advisory, committees- local contractors co-operation with the press news and articles- facilities for  
visitors- forms of publicity importance of quality -inter departmental liaison advertisements, signs, notice  
and directions general appearance of premises, specialized publicity.

UNIT-III  
Prevention of accidents: Emphasis of safe driving-annual awards bonus encouragement vehicle design  
platform, layout, location of steps, scheduled route hazards records elimination of accident prone devices.  
Route planning: Source of traffic, town planning, turning paints, stopping places, shelters survey of route  
preliminary schedule test runs elimination of hazards factors affecting. Frequency direction of traffic flow  
estimated traffic possibility single versus double deck.

UNIT-IV  
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. Fare collections systems: Principles of collection the way bill, bell punch system reduced ticket  
stocks wilk brew system T.I.M and straight M/C/S. The verometer lenson parason coach tickets exchanges,  
box system personal and common stock flat fare platform control.

UNIT-V  
The fare structure: Basis of fares historical background effects of competition and control calculating average  
zone system straight and tapered scale elastic and inelastic demand coordination of fares concessions fares  
changes for workman. Anomalies double booking inter availability through booking and summation private hire  
charges. Operating cost and types of vehicles: Classification costs, average speed running costs
supplementary costs depreciation obsolescence, life of vehicles sinking fund factor affecting post 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 cars.

TEXTBOOKS:
1. Bus operation -L.d kitchen, iliffe & sons
2. Bus & coach operation -Rex w. fautks. butterworth version of 1987

EAU022 AITTMOTIVE ELECTRICAL AND AUTORONICS

UNIT-I:
Storage Battery: Principles of lead acid cells and their characteristics, construction and working of lead acid
battery. types of batteries, testing of batteries, effect of temperature on capacity and voltage, battery
capacity, voltage, efficiency, charging of batteries, sulphation and desulphation, maintenance and servicing.

UNIT-II:
Ignition System: Conventional ignition system and study of its components. Types of ignition systems,
spark advance and retarding mechanisms. Types of spark plugs, ignition timing, maintenance, servicing
and fault diagnosis. Electronic ignition systems, programmed ignition, distributorless ignition,
a) Starter motor: Construction and working of series and shunt automotive starter motor, types of device
arrangement, solenoid switches, starter motor troubles and repairs.
b) Electronic controls of carburetion, component of fuel injection systems, multipoint injection. Bosch
Lvariation electronic control diesel fuel injection.

UNIT-III:
Charging system: Principle of generation of direct current. Principle, construction and working of
Wiring for auto
electrical Systems: Earth return and insulated return systems, six volt and twelve volt systems, fusing of
circuits, low and high voltage automotive cables, wiring diagram for typical automotive wiring systems,
maintenance and servicing.

Unit-IV:
Dash board units and electrical accessories: Principle of automobile illumination, head lamp construction and
wiring, hom, wind screen wiper signalling devices, fog lamps, auxiliary lighting, temperature gauge, oil
pressure gauge, fuel gauge, speedometer, odometer.

Unit-V
Number system codes and data representation: Binary numbers, number base conversion, decimal, octal
and hexadecimal numbers, BCD codes, memory representation of positive and negative integers,
conversion real numbers, floating point notations and representations of floating point numbers, binary
arithmetics, addition and subtraction of binary numbers, ones and two's complement method. Logic gates,
arithmetic circuits and introduction to microprocessors: Study of basic and universal logic gates, study of
X-OR and X-NOR gates, flip flop, S-R, S-J flip flop and counters.and shift resistance, half adders and
subtractors.

TEXTBOOKS:
1. Automotive Electrical auxiliary systems -By N R. Khatawale Digital
2. Logic and Computer Design by Mano, Prentice hall of India

REFERENCES:
1. Automotive Electrical systems -By Young and Griffith, Butterworth
2. Basic automotive electrical systems -By C.P. Naka, Dhanpat Rai.
3. Automotive mechanics -By William H. Grouse, TMH 5. Modern Electrical Equipments -By A. W. Judge,
4. Automotive Electrical Equipment -By P.I. Kohli, TMH

EAU 023 PRODUCT DESIGN AND ASSEMBLY AUTOMATION  L T P
3 1 0

UNIT-I

UNIT-II
Assembly Automation: Development of the assembly process, choice of assembly method, automation advantages, social effects of automation.
automatic assembly transfer systems: Continuous transfer. Intermittent transfer, indexing mechanisms, and operator paced free transfer machine.

UNIT-III
product design for high speed automatic assembly and robot assembly: Introduction, design of parts for: high speed, feeding and orienting, example, additional feeding difficulties, high speed automatic insertion, example, analysis of an assembly, general rules for product design for automation, design of parts for feeding and orienting, summary of design rules for high speed automatic assembly, product for robot assembly.

UNIT-IV
design of manual assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of Insertion time.

UNIT-V
Avoiding jams during assembly, reducing risk assembly problems, effects of holding down, manual assembly data base and design data sheets, application of the DFA methodology and general design guidelines, performance and economics of assembly systems: indexing machines, free transfer machines, basis for economic comparisons of automation equipment, comparison of indexing and free transfer machines' economics of robot assembly.
feasibility study for assembly automation: machine design factors to reduce machine downtime due to defective parts, feasibility study.
Department Elective-III

EAU 031 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 AND CONTROLS
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: AERODYNAMICS AND 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, chassis 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 OF VEHICLES
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.

[40]
EAU 032 AUTOMOTIVE AERODYNAMICS

UNIT I
INTRODUCTION

UNIT II
AERODYNAMIC DRAG OF CARS

UNIT III
SHAPE OPTIMIZATION OF CARS
Front end modification - front and rear wind shield angle - Boat tailing - Hatch back, fast back and square back Dust flow patterns at the rear - Effects of gap configuration - effect of fasteners.

UNIT IV
VEHICLE HANDLING
The origin of forces and moments on a vechile - side wind problems - methods to calculate forces and moments - vehicle dynamics Under side winds - the effects of forces and moments - Characteristics of forces and moments - Dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles.

UNIT V
WIND TUNNELS FOR AUTOMOTIVE AERODYNAMIC
Introduction - Principle of wind tunnel technology - Limitation of simulation - Stress with scale models - full scale wind tunnels - measurement techniques - Equipment and transducers - road testing methods - Numerical methods.

TEXTBOOKS:

References:
2. Automotive Aerodynamic: Update SP-706, SAE,
UNIT-I
Single Variable Optimization for engineering design: Introduction-Engineering optimization problems-
Optimality criteria-Bracketing

UNIT-II
methods-Region elimination methods-Point estimation methoOds-Gradient based methods-Root finding using
ptimization techniques-Computer programmes.

UNIT III:
Multi Variable Optimization Algorithm: Optimality criteria-Unidirectional search-Direct search methods-
gradient based methods-Computer programmes.

UNIT IV:
Constrained Optimization Algorithms: Kuhn - Tucker conditions -Transformation methods - sensitivity analysis
Direct search for constrained minimization-Unearized search techniques - feasible direct method-generalized
duction gradient method-Gradient projection method- Computer programmes.

UNIT V:
Specialized Algorithms : Integer programming - Geometric programming.
Non-Traditional Optimization Algorithms: Genetic algorithms - Simulated annealing - Global optimization
Computer programmes.

REFERENCES:
5. Rekiaaitis. G.V. Ravindran.A. And Regedell K.M., Engineering optimization methods and applications,
UNIT I

UNIT II

UNIT III
42 Volt System: Need, benefits, potentials and challenges. Technology Implications for the Automotive Industry. Technological evolution that will occur as a result of the adoption of 42 volt systems. Power system; power peering, power brakes, windows, Automated systems; computer controlled front collision prevention, navigation, GPS, engine check diagnosis system, wheel status air pressure, alignment, number of liters of diesel left, kilometers to be covered, mileage at each discrete interval. Preparation and maintenance of proper road network - National highway network with automated roads and vehicles - Satellite control of vehicle operation for safe and fast travel. Computer Control for pollution and noise control and for fuel economy - Transducers and actuators -Information technology for receiving proper information and operation of the vehicle like optimum speed and direction.

UNIT IV

UNIT V
TEXT & REFERENCE BOOKS:
2. Electric and Hybrid Electric vehicles by Ronald K. Jurgen.- SAE International Publication
4. Electronics steering and suspension systems- SAE Hardbound papers.
5. 42 Volt system by Daniel J. Holt- SAE International Publication

EAU042 AUTOMOTIVE AIR-CONDITIONING

UNIT I: AIRCONDITIONING FUNDAMENTALS
Basic air conditioning system - Location of air conditioning components in a car - Schematic layout of a refrigeration system. Compressor components - Condenser and high pressure service ports. Thermostatic expansion value - Expansion value calibration - Controlling evaporator temperature - Evaporator pressure regulator - Evaporator temperature regulator.

UNIT II: AIR CONDITIONER - HEATING SYSTEM REFRIGERANT

UNIT III: AIR ROUTING & TEMPERATURE CONTROL
Containers - Handling refrigerants - Tapping into the refrigerant container - Refrigeration system diagnosis - Diagnostic procedure - Ambient conditions affecting system pressures. Evaporator care air flow through the Dash recirculating unit - Automatic temperature control - Duct system - Controlling flow - Vacuum reserve - Testing the air control and handling systems.

UNIT-IV: AIR CONDITIONING SERVICE
Air conditioner maintenance and service - Servicing heater system Removing and replacing components. Trouble shooting of air controlling system - Compressor service.

TEXT BOOK:

REFERENCES:
UNIT-I
Introduction, Application area of Computer graphics, overview of graphic system, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices

UNIT-II
Output primitives: Points and lines, line drawing algorithms, mid-point circle algorithm. Filled area primitives: scan-line polygon fill algorithm, boundary-fill and flood-fill algorithm. 2-D geometrical transformations: Translation, scaling, rotation, reflection and shear transformation matrix representations and homogeneous coordinates, composite transformations, transformations between coordinates

UNIT-III
2-D viewing: The viewing pipe-line, viewing coorclinat4 reference frame, window to view-port co-ordinate transformations, viewing function. Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland-Hodgeman polygon clipping algorithm

UNIT-IV
3-D object representation: Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-spline curve, Bezier and B-spline surfaces, Basic illumination models, shading algorithms
3-D geometric transformations: Translation, rotation, scaling, reflection and shear transformation and composite transformations

UNIT-V
Visible surface detection methods: Classification, back-face detection, depth-buffer, scan-line, depth sorting
Computer animation: Design of animation sequence, general computer animation functions, raster animation, computer animation language, key frame system, motion specification

TEXT BOOKS:

REFERENCES:
5. Computer Graphics. Steven Harrington, TMH
Departmental Elective – V

EAU 051: COMPUTER AIDED VEHICLE DESIGN       L T P
                                                  3 1 0

Unit I:
VEHICLE FRAME AND SUSPENSION
Study of loads - moments and stresses on frame members. Computer aided design of frame for
passenger and commercial vehicle - Computer aided design of leaf springs - Coil springs and torsion
bar springs.

UNIT II:
FRONT AXLE AND STEERING SYSTEMS
Analysis of loads - moments and stresses at different sections of front axle. Determination of bearing loads at
Kingpin bearings. Wheel spindle bearings. Choice of bearings. Determination of optimum dimensions and
proportions for steering linkages ensuring minimum error in steering.

UNIT III:
CLUTCH
Torque capacity of clutch. Computer aided design of clutch components, Design details of roller and sprag type
of clutches.

UNIT IV:
GEARBOX
Computer aided design of three speed and four speed gear boxes.

UNIT V: DRIVE LINE AND READ AXLE
Computer aided design of propeller shaft. Design details of final drive gearing. Design details of full
floating, semi-floating and three quarter floating rear shafts and rear axle housings.

TEXT BOOKS:

References:
UNIT-I

UNIT-II
Solar photo-voltaic conversion, Collection and storage of solar energy, collection devices, flat plate collectors, concentrating type collectors, principles and working of photo-voltaic Conversion, Applications to automobiles.

UNIT-III

UNIT-IV

UNIT-V
Hydrogen fuel, Storage and Transportation methods, Applications to engines modifications necessary, precautions aod safety measures - Performance characteristics in Engine and their comparison.

UNIT-VI
Electric Automobiles: Design considerations, limitations, opportunities for improvement Batteries, problems, future possibilities , capacities, types , material requirement, Applicability of electric cars, comparative use of fuel and energy. Availability of energy for recharging, impacts on use of fuel and energy .impact on urban air quality, impact on price, material requirement Traction motors and types.

UNIT-VII
Vegetable Oils: Various vegetable oils for engines-Esterification-Performance in engines-Performance and emission characteristics.

UNIT-VIII
Use of gas turbines in cars, arrangement, control merits and de- merits. Design of turbochargers for automobiles, their usefulness on the performance.

Text Books:
1. G.D. Rai 'Non-conventional sources of energy Khanna Lab.
2. William Hamilton 'Electric Automobiles', PHI

Reference Books:
2. S. Rao & B.B. Larulekar 'Energy Technology', Khanna Lab
5. T.N. Veziroglu. Alternative energy sources.
Objectives: To import knowledge of vibrations due to different aspects like road construction and vibration measuring techniques to the students

UNIT-I

UNIT-II
Damped free vibration: Single degree of freedom systems, different types of damping, concept of critical damping and its importance, response study of viscous damped systems for cases of under damping and over damping, logarithmic decrement

UNIT-III
Forced vibration: Single degree of freedom systems, steady state solution with viscous damping due to harmonic force solution by complex algebra, concept of response, reciprocating and rotating unbalance, vibration isolation Transmissibility ratio, energy dissipated by damping equivalent. viscous damping. Structural damping, sharpness or resonance, base excitation.

UNIT-IV
Vibration measuring instruments -Accelerometers and vibrometers. whirling of shafts with and without air damping, discussion of speeds above and below critical speeds

UNIT-V
Systems with two degree of freedom : Introduction, principle modes and normal modes” co-ordinate coupling, generalised and principle co-ordinate, free vibrations in terms of natural conditions. Lagrages equation, semi-definite systems, forced oscillations, harmonic excitation.

UNIT-VI
Vehicle vibrations: Vehicle vibration with single degree of freedom free vibration, forced vibration, vibration due to road roughness, vibration due to engine unbalance, transmissibility of engine mounting vibration with two degree of freedom, free vibration, compensated suspension systems forced vibration, vibration due to road roughness.

UNIT-VII
Different types of tyres - Materials used: Tyre construction, physics of tyre traction on dry and wet surface, tyre traction on dry and wet surface, tyre forces and moments, SAE recommended terminologies of tyre road interaction.

UNIT-VIII

TEXTBOOKS:
1. Mechanical Vibration -By O.K. Grover, Nemchand & Brothers
6. Mechanical Vibration Analysis -By PSrinivasan, TMH
Department Elective-VI

**EAU 061 COMPUTER SIMULATION OF 1C ENGINES PROCESS**

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<thead>
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<th>Unit I</th>
<th>INTRODUCTION</th>
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<tr>
<th>Unit II</th>
<th>SI ENGINE SIMULATION WITH AIR AS WORKING MEDIUM</th>
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<tbody>
<tr>
<td>Deviation between actual and ideal cycle - Problems, SI engine simulation with adiabatic combustion. temperature drop due to fuel vaporization, full throttle operation - efficiency calculation, part-throttle operation, super charged operation.</td>
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<table>
<thead>
<tr>
<th>Unit III</th>
<th>PROGRESSIVE COMBUSTION</th>
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</thead>
<tbody>
<tr>
<td>SI Engines simulation with progressive combustion with gas exchange process, Heat transfer process,’ friction calculation, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram and other engine performance.</td>
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<tr>
<th>Unit IV</th>
<th>SIMULATION OF 2-STROKE SI ENGINE</th>
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<td>Simulate the performance, unbalanced forces on two stroke engine.</td>
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<tr>
<th>Unit V</th>
<th>DIESEL ENGINE SIMULATION</th>
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<tr>
<td>Multi zone model for combustion, different heat transfer models, equilibrium calculations, simulation of engine performance, simulation for pollution estimation.</td>
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</table>

**References:**

EME-061: FINITE ELEMENT METHOD

UNIT-I
Introduction
Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Elements of variational calculus - Euler Lagrange equation, Rayleigh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM.

UNIT-II
Types of Elements Used
Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate systems.

UNIT-III
Finite Element Formulation of Field Problems
1-D and 2-D heat transfer, fluid flow (incompressible and non viscous fluid) in ducts, Simple electrical and magnetic field problems. Simple Numerical examples

UNIT-IV
Finite Element Formulation of Solid Mechanics Problems

UNIT-V
Numerical Methods in FEM

Books:
6. Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu Prentice Hall India
7. Finite Element and Approximation O.C. Zenkiewicy & Morgan –
OBJECTIVE:
The course aims to make student understand the structure and the properties of the fluid. To understand and appreciate the complexities involved in solving the fluid flow problems. To understand the mathematical techniques already in vogue and apply them to the solutions of practical flow problems. To understand the energy exchange process in fluid mechanics handling incompressible fluids.

UNIT-I
BASIC CONCEPT & PROPERTIES
Fluid - definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressure measurements by manometers and pressure gauges.

UNIT-II: FLUID KINEMATICS AND FLUID DYNAMICS
Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms) - Equation of streamline - stream function - velocity potential function - circulation - flow net. Equations of motion - Euler's equation along a streamline - Bernoulli's equation - applications - venturi meter. Orifice meter, other flow measurement instruments, Pilot Tube.

UNIT-III
DIMENSIONAL ANALYSIS
Dimensional numbers, their application. - Buckingham's theorem - applications - similarity laws and models.

UNIT-IV: INCOMPRESSIBLE FLUID FLOW
Viscous flow - Navier- Stroke's equation (Statement only) - Shear stress, pressure gradient relationship laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) - Hydraulic and energy gradient - flow through pipes - Darcy - weisback's equation - pipe roughness - friction factor - Mody's diagram - minor losses - flow through pipes in series and in parallel - power transmission - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

UNIT-V
HYDRAULIC TURBINES, HYDRAULIC PUMPS, COMPRESSOR & FANS

TEXTBOOKS
3. Hydraulic Machines- Theory and Design by Vasaadani, V.P., Khanna Publishers, 1992
List Of Open Elective for B.Tech. Courses

**SCIENCE BASED OPEN ELECTIVE**

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<tr>
<th>Code</th>
<th>Course</th>
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<td>EOE-031 / EOE-041</td>
<td>Introduction to soft Computing (Neural Network, Fuzzy Logic and Genetic Algorithm)</td>
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<tr>
<td>EOE-032 / EOE-042</td>
<td>Nano Sciences</td>
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<tr>
<td>EOE-033 / EOE-043</td>
<td>Laser Systems and Applications</td>
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<td>EOE-034 / EOE-044</td>
<td>Space Sciences</td>
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<td>EOE-035 / EOE-045</td>
<td>Polymer Science &amp; Technology</td>
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<td>EOE-036 / EOE-046</td>
<td>Nuclear Science</td>
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<td>AUTOMOTIVE CHASSIS, SUSPENSION AND TRANSMISSION</td>
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**OPEN ELECTIVE-I**

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<td>EOE-072</td>
<td>Quality Management</td>
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<td>EOE-073</td>
<td>Operation Research</td>
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<td>EOE-074</td>
<td>Introduction to Biotechnology</td>
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**OPEN ELECTIVE-II**

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<tr>
<td>EOE-081</td>
<td>Non Conventional Energy Resources</td>
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<td>EOE-082</td>
<td>Nonlinear Dynamic system</td>
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<tr>
<td>EOE-083</td>
<td>Product Development</td>
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<tr>
<td>EOE-084</td>
<td>Automation &amp; Robotics</td>
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