Automobile Engineering (AU)

EN010301A ENGINEERING MATHEMATICS II
(Common to all branches except CS & IT)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives

- *To apply standard methods and basic numerical techniques for solving problems and to know the importance of learning theories in Mathematics.*

MODULE 1 Vector differential calculus (12 hours)

Scalar and vector fields – gradient-physical meaning- directional derivative-divergence an curl - physical meaning-scalar potential conservative field- identities - simple problems

MODULE 2 Vector integral calculus (12 hours)

Line integral - work done by a force along a path-surface and volume integral-application of Greens theorem, Stokes theorem and Gauss divergence theorem

MODULE 3 Finite differences (12 hours)

Finite difference operators Δ, ∇, E, μ and δ - interpolation using Newtons forward and backward formula – problems using Stirlings formula, Lagrange's formula and Newton's divided difference formula

MODULE 4 Difference Calculus (12 hours)

Numerical differentiation using Newtons forward and backward formula – Numerical integration – Newton's – cotes formula – Trapezoidal rule – Simpsons $1/3^{rd}$ and $3/8^{th}$ rule – Difference equations – solution of difference equation

MODULE 5 **Z** transforms (12 hours)

Definition of Z transforms – transform of polynomial function and trignometric functions – shifting property , convolution property - inverse transformation – solution of 1^{st} and 2^{nd} order difference equations with constant coifficients using Z transforms.

Reference

1. Erwin Kreyszing – Advance Engg. Mathematics – Wiley Eastern Ltd.
2. B.S. Grewal – Higher Engg. Mathematics - Khanna Publishers
3. B.V. Ramana - Higher Engg. Mathematics – McGraw Hill
4. K Venkataraman- Numerical methods in science and Engg -National publishing co
5. S.S Sastry - Introductory methods of Numerical Analysis -PHI
6. T.Veerarajan and T.Ramachandran- Numerical Methods- McGraw Hill
7. Babu Ram – Engg. Mathematics -Pearson.
8. H.C.Taneja Advanced Engg. Mathematics Vol I – I.K.International

EN010 302 Economics and Communication Skills

(Common to all branches)

Teaching scheme
2hours lecture and 2 hours tutorial per week **Credits: 4(3+1)**
Objectives

- To impart a sound knowledge of the fundamentals of Economics.

Economics

Module I (7 hours)
Reserve Bank of India-functions-credit control-quantitative and qualitative techniques
Commercial banks-functions- Role of Small Industries Development Bank of India and National Bank for Agriculture and Rural Development
The stock market-functions-problems faced by the stock market in India-mutual funds

Module II (6 hours)
Multinational corporations in India-impact of MNC's in the Indian economy
Globalisation-necessity-consequences
Privatisation-reasons-disinvestment of public sector undertakings
The information technology industry in India-future prospects
Module III (6 hours)
Direct and indirect taxes- impact and incidence- merits of direct and indirect taxes-progressive and regressive taxes-canons of taxation-functions of tax system-
tax evasion-reasons for tax evasion in India-consequences-steps to control tax evasion
Deficit financing-role-problems associated with deficit financing

Module IV (5 hours)
National income-concepts-GNP, NNP, NI, PI and DPI-methods of estimating national income-difficulties in estimating national income
Inflation-demand pull and cost push-effects of inflation-government measures to control inflation

Module V (6 hours)
International trade-case for free trade-case for protectionism
Balance of payments-causes of disequilibrium in India's BOP-General Agreement on Tariffs and Trade-effect of TRIPS and TRIMS in the Indian economy-impact of WTO decisions on Indian industry

Text Books

1. Ruddar Datt, Indian Economy, S.Chand and Company Ltd.
2. K.K.Dewett, Modern Economic Theory, S.Chand and Company Ltd.

References

1. Paul Samuelson, Economics, Tata McGraw Hill
2. Terence Byres, The Indian Economy, Oxford University Press
3. S.K.Ray, The Indian economy, Prentice Hall of India
4. Campbell McConnel, Economics, Tata McGraw Hill

Communication Skills

Objectives

- To improve Language Proficiency of the Engineering students
- To enable them to express themselves fluently and appropriately in social and professional contexts
- To equip them with the components of different forms of writing

MODULE – 1 (15 hours)

INTRODUCTION TO COMMUNICATION

Communication nature and process, Types of communication - Verbal and Non verbal, Communication Flow-Upward, Downward and Horizontal, Importance of communication skills in society, Listening skills, Reading comprehension, Presentation Techniques, Group Discussion, Interview skills, Soft skills

MODULE – II (15 hours)

TECHNICAL COMMUNICATION

Technical writing skills- Vocabulary enhancement-synonyms, Word Formation-suffix, affix, prefix, Business letters, Emails, Job Application, Curriculum Vitae, Report writing-Types of reports

Note: No university examination for communication skills. There will be internal evaluation for 1 credit.

REFERENCES

1. The functional aspects of communication skills, P.Prasad and Rajendra K. Sharma, S.K. Kataria and sons, 2007
2. Communication skills for Engineers and Scientists, Sangeeta Sharma and Binod Mishra, PHI Learning private limited, 2010
3. Professional Communication, Kumkum Bhardwaj, I.K. International (P) House limited, 2008
4. English for technical Communication, Aysha Viswamohan, Tata Mc Graw Publishing company limited, 2008

AU010 303: Fluid Mechanics and Hydraulic Machinery

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *The student is introduced to the mechanics of fluids through a thorough understanding of the properties of the fluids.*
- *The dynamics of fluids is introduced through the control volume approach which gives an integrated under standing of the transport of mass, momentum and energy.*
- *The applications of the conservation laws to flow though pipes and hydraulics machines are studied*

Module I (12 hours)

Properties of fluids- pressure, force, density, specific weight, compressibility, capillarity, surface tension, dynamic and kinematic viscosity, Newtonian and non-Newtonian fluids. Pascal's law-fluid statics-measurement of pressure-manometry, –various types of manometers and pressure gauges.
Buoyancy – Centre of buoyancy –Metacentre– Stability of floating bodies – Determination of metacentric height.

Module II (12 hours)

Kinematics of flow, velocity, acceleration, circulation and vorticity.
Continuity equation for one dimensional steady flow – Bernoulli's equation for steady one dimensional incompressible flow – venturimeter – Orifice meter – Pitot tube, Orifice and mouth piece.
Types of flow – Streamline, Path line and Streak line, Stream tube, Velocity Potential, Stream Function, Flow Net- Laplace's Differential equation in rectangular co-ordinates for two dimensional irrotational flow

Module III (12 hours)

Flow through pipes**:** Laminar and Turbulent flow – Reynold's experiment, loss of head due to friction, Darcy – Weishbach Equation, Chezy's formula, Minor losses in pipes.
Hydraulic Gradient and Total Energy Lines**:** Flow through long pipes – Pipes in series and parallel, Siphon, Power Transmission through pipes and flow through nozzles.
Laminar Flow: Navier Stoke's Equation ,Hagen poiseuille Equation, Flow through open channels: Notches – Weirs.

Module IV (12 hours)

Impact of jet on vanes – flat, curved, stationary and moving vanes, continuity equation and momentum equation, hydraulic turbines – classification, velocity triangle for Pelton wheel and Francis turbine– work done and efficiency–specific speed – draft tube – tail race – pen stock, water hammer- surge tank – governing – cavitation – selection of water turbines for power plants.

Module V (12 hours)

Centrifugal Pumps: Classifications-types of casing and impellers, Velocity triangle for pumps, Head of pump, Losses and efficiency, Minimum starting speed, Specific speed, NPSH, Multistage pump, Pumps in parallel and series, selection of pumps.
Positive displacement pumps – working principle, types of reciprocating pumps, Indicator diagram- work done, effect of acceleration and frictional resistance, slip and coefficient of discharge., separation in suction and delivery pipes, Air vessel.
Gear pump, Lobe pump, Vane pump, Screw pump

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Text Books

1. Dr. Bansal R.K., A Text book of Fluid Mechanics and Hydraulics Machines, Laxmi publications, New Delhi.
2. Jagadish Lal, Fluid mechanics and Hydraulic machines, Metropolitan Book Co Pvt Ltd

Reference Books

1. Frank M White ,Fluid Mechanics, Tata McGraw Hill publishing
2. K Muralidhar & G.Biswas , Advanced Engineering fluid mechanics, Narosa
3. Dr. P.N.Modi , Dr. S.M. Seth , Hydraulics and Fluid Mechanics , Standard book house
4. Ramamritham. S, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi
5. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India, Delhi.
6. Irving H Shames , Mechanics of fluids, McGraw Hill
7. R.K.Rajput, Textbook of Fluid Mechanics & Hydraulic Machines, S Chand & Company Ltd

AU010 304(ME): Metallurgy and Material Science

(Common with PE 010 304(ME) and ME010 304)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide physical concepts of atomic radius, atomic structure, chemical bonds, crystal structure, grain size, work hardening,, heat treatment etc. of metals with mechanical behaviour.*
- *To understand the causes of metal failure and deformation*
- *To determine properties of unknown materials and develop an awareness to apply this knowledge in material design.*

Module 1 (12 hours)

Atomic structure:- Correlation of atomic radius to strength, electron configurations (basic only) - **Primary bonds**:- Covalent and Ionic bond: bond energy with strength, cohesive force, density, directional and non-directional bonding; Metallic bond: conductivity, ductility, opaque, lustrous, density, non directional bonding – **Specific properties of bonding**:- Deeper energy well bond and shallow energy well bond, melting temperature, modulus of elasticity, coefficient of thermal expansion and attributes of modulus of elasticity in metal cutting process - **Secondary bonds:-** classification, hydrogen bond, specific heat etc.

Crystallography:- Crystal, space lattice, unit cell - BCC, FCC, HCP structures - short and long range order - Effects of crystalline and amorphous structure on mechanical properties - Determination of atomic packing factor of SC, BCC, FCC, coordination number; densities - Polymorphism and allotropy - **Miller Indices:-** slip system, brittleness of BCC, HCP and ductility of FCC - **Modes of plastic deformation:-** Slip, twinning, Schmid's law, correlation of slip system with slip in metals.

Module 2 (12 hours)

Classification of crystal imperfections: - types of **dislocation**, source of dislocation, cross slip, climb, jog, kink, forest of dislocation, role of surface defects on crack initiation - Burgers vector - Correlation of dislocation density with strength and nano concept - Significance of **Frank and Read source** in metals deformation - **Mechanism of crystallization:** Homogeneous and heterogeneous nuclei formation, under cooling, dendritic growth, grain boundary irregularity - Effects of grain size, grain size distribution, grain shape, grain orientation on dislocation/strength and creep resistance - Hall - Petch equation; significance high and low angle grain boundaries on dislocation - – polishing and etching to determine the microstructure - crystal structure determination by **X - ray diffraction** method - ***Diffusion*** in solids, fick's laws, mechanisms, applications of diffusion in mechanical engineering.

Module 3 (12 hours)

Phase diagrams: - Limitations of pure metals and need of alloying - classification of alloys, solid solutions, Hume Rothery`s rule - single phase, multi-phase equilibrium diagrams - lever rule and Gibb`s phase rule - Coring - Equilibrium diagrams reactions:- monotectic, eutectic, eutectoid, peritectic, peritectoid - Detailed discussion on **Iron-Carbon equilibrium diagram** with **microstructure** and properties changes in austenite, ledeburite, ferrite, cementite, interlamellar spacing of pearlite to strength etc, special features of martensite transformation, bainite, spheroidite etc..

Heat treatment:- Definition and necessity - TTT diagrams - critical cooling rate (CCT) - annealing, normalizing, hardening, spheroidizing - Tempering:- austermpering, martempering and ausforming - Hardenability, Jominy end quench test, applications – hardness and micro-hardness tests - **surface hardening methods**:- carburizing processes; Nitriding; Flame, induction, laser and electron beam hardening processes; applications - **Types of Strengthening mechanisms:-** grain size reduction, work hardening, Solid solution hardening, precipitation strengthening and over ageing, dispersion hardening - **Cold working**: Detailed discussion on strain hardening; recovery; re-crystallization, effect of stored energy; re-

crystallization temperature, effect of grain size; driving force for grain growth - **hot working** - Bauschiner effect and attributes in metal forming.

Module 4 (12 hours)

Alloy steels:- Effects of alloying elements on: dislocation movement, polymorphic transformation temperature, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties – Nickel steels, Chromium steels etc. - Enhancement of **steel properties** by **adding alloying elements:-** Molybdenum, Nickel, Chromium, Vanadium, Tungsten, Cobalt, Silicon, Copper and Lead – **High speed steels:-** Mo and W types, effect of different alloying elements in HSS - **Cast irons**: Classifications, grey, white, malleable and spheroidal graphite cast iron, composition, microstructure, properties and applications – Principal **Non ferrous Alloys: -** Aluminum, Copper, Magnesium, Nickel, Titanium, study of composition, microstructure, properties, applications, reference shall be made to the phase diagrams whenever necessary.

Module 5 (12 hours)

Fracture: – Brittle and ductile fracture - Griffith theory of brittle fracture - stress concentration, stress raiser – Effect of plastic deformation on crack propagation – transgranular, intergranular fracture - Effect of impact loading on ductile material and its application in forging etc.- **Fatigue**:- Stress cycles – Primary and secondary stress raisers - Characteristics of fatigue failure, S-N curve - Factors affecting fatigue strength: stress concentration, size effect, surface roughness, change in surface properties, surface residual stress -Ways to improve fatigue life – effect of temperature on fatigue, thermal fatigue and its applications in metal cutting – Mechanism of fatigue failure – structural features of fatigue:- crack initiation, growth, propagation – fatigue tests - Fracture toughness (definition only) - Ductile to brittle transition temperature **(DBTT)** in steels - **Creep**:- Creep curves – creep tests- Structural change:- deformation by slip, sub-grain formation, grain boundary sliding – Mechanism of creep deformation - threshold for creep - prevention against creep- **Super plasticity:** applications.

Text Books

1.Introduction to Physical Metallurgy – Tata McGraw Hill.
2.Callister William. D. – Material Science and Engineering – John Wiley.
3.Dieter George E. – Mechanical Metallurgy – McGraw Hill.
4.Higgins R.A. – Engineering Metallurgy part - I – ELBS.
5.Raghavan V. - Material Science and Engineering - Prentice Hall.
6. Van Vlack – Elements of Material Science - Addison Wesley.

Reference Books

1.Anderson J.C. *et.al*. – Material Science for Engineers – Chapman and Hall.
2.Clark and Varney - Physical metallurgy for Engineers – Van Nostrand.
3.Manas Chanda - Science to Engineering Materials - Vol I, II and III - Macmillan India.
4.Reed Hill E. Robert – Physical Metallurgy Principles – East West Press.
5.Richards C.W. – Engineering Material Science.

AU010 305: Programming in C

(Common with PE010 305 and ME010 305)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart advanced knowledge in programming in C language*

Module I (15 hours)

Introduction to computer programming; Various I/O functions; Data types; Constants and Variables; Escape Sequences; Type Casting; Preprocessor Directive; Storage Classes; Scope of Variables; Mathematical Operators; Relational Operators; Branching Instructions; Logical Operators; Conditional Operator; Precedence of Operators; Loops – for, while and do-while, break and continue instructions, Nested Loops; Switch statement; Evaluation of e^x, sin(x), cos(x) Numerical Integration using Trapezoidal and Simpson's rules.

Module II (10 hours)

Arrays; One Dimensional Arrays; Selection Sorting; Binary Searching; Various String Handling Functions; Multidimensional Arrays; Matrix Operations (Addition, Transpose and Multiplication); Sorting of Strings; Structure and Union; Array of Structures;

Module III (10 hours)

Functions; Call by Value Method; Stack; Passing One Dimensional and Multidimensional Arrays to a Function; Recursion; Writing Different String Handling Functions Using Simple Functions and Functions with Recursive Calls; Quick Sorting; Macros; Writing Macros for Simple Operations;

Module IV (15 hours)

Declaration of Pointers; Call by Reference Method; Pointer to a Structure; Pointer to an Array; Array of Pointers; Pointer to a Pointer; Self Referential Structure; Dynamic Memory Allocation; Reallocation of Memory; Linear Linked List; Circular Linked List; Double Linked List; Addition, Insertion and Deletion of Nodes from a Linked List; Command Line Arguments

Module V (10 hours)

Different types of Files; Reading, Writing, Appending and Rewriting of Text and Binary Files; Transfer of Data in Blocks; Moving of File Pointer in a File; Usage of bitwise AND, OR, NOT, XOR, Shift Left and Shift Right Operations

Text Books

1. Bryon S.Gottfried, *Programming with C Language*.

Reference Books

1. Balaguruswamy, *Programming in ANSI C,*
2. Deitel, *How to Program C*
3. Kamthane, *Programming with ANSI and Turbo C*

AU010 306(CE) Strength of Materials & Structural Engineering

(Common with ME010 306(CE), PO010 306(CE) and PE010 306(CE))

Teaching Scheme:-
3 hours lecture and 1 hour tutorial per week **Credits**: 4

Objectives

- *To study internal effects produced and deformations of bodies caused by externally applied forces.*
- *To understand the stresses and strains in different materials and analyse strength characteristic of structural members.*

Module I (15 hours)
Introduction to analysis of deformable bodies:-
stresses due to normal, shear and bearing loads-Axial and shear strains –
Simple stresses and strains: Material behavior - uniaxial tension test - stress-strain diagrams. Hooke's law for linearly elastic isotropic material.
Elastic constants - relation between them - Bars of varying cross section -Composite sections- Equilibrium and compatibility conditions- Temperature stresses

Module II (10 hours)
Bending moment and shear force: Cantilever, simply supported and overhanging beams - concentrated and U.D loading(analytical method) Relation between load shear force and bending moment.

Module III (15 hours)
Stresses in beams: Pure bending - flexure formula for beams - assumptions and limitations -section modulus - flexural rigidity - economic sections beams of uniform strength. Shearing stress formula for beams - assumptions and limitations.
Deflection of beams: Moment-curvature relation - assumptions and limitations singularity functions - Macaulays method - moment area method for simple cases.

Module IV (10 hours)
Torsion: Torsion theory of elastic circular bars – solid and hollow shaft assumptions and limitations - polar modulus- torsional rigidity - economic cross-sections.
Pressure vessels: Thin and thick cylinders-Lame's equation-stresses in thick cylinders due to internal pressure – compound pipes.

Module V (10 hours)
Combined stresses: Principal stresses and planes-Mohr's circle representation of stress in 2D problems. Use of strain gage rosettes. Combined axial, flexural and torsional loads.
Theory of columns: Buckling theory -Euler's formula for long columns - assumptions and limitations - effect of end conditions - slenderness ratio - Rankine's formula for intermediate columns -Eccentric loading of columns - kern of a section (rectangular and circular section).

Text Books

1. Timoshenko.S.P, Strength of Materials, Part 1,D.Van Nostrand company, Inc.Newyork.
2. Bansal R.K., Strength of Materials, Lakshmi Publications, New Delhi.
3. Mott, Robert L, Applied strength of materials, 5th Edn, Prentice Hall of India.
4. Popov E.P., Engineering Mechanics of solids, Prentice Hall of India, New Delhi..

Reference Books

1. Nash.W.A , Strength of Materials, Schaum's Outlines,$th Edn, TMH
2. Gere, James M , Mechanics of Materials, Cengage Learning.
3. Shames IH , Pitarresi, James.M, Introduction to Solid Mechanics, Prentice Hall of India.

AU010 307: Computer Lab

(Common with PE010 408 and ME010 307)

Objectives

- *To provide experience in programming with C language*
- *To familiarize with operating systems. file directories, editors, compilers and file managers etc.*
- *To obtain exposure to computer programming languages for technical computation like MatLab*
- *Programming experiments in C to cover control structures functions, arrays, structures, pointers and files*

i. Counting characters, lines and words
ii. Checking leap year
iii. Finding sum of digits and reversing a number
iv. Generating Prime numbers, Fibonacci numbers and Angstrom numbers
v. Sine and Cosine series generation
vi. Implementation of Numerical Integration using Simpson's and Trapezoidal rules
vii. Sorting of numbers, strings and records
viii. Matrix addition and multiplication
ix. Implementation of dynamic memory allocation
x. Implementation of linked lists
xi. Problems related to files
xii. Problems related to command line arguments

AU010 308: Fluid Mechanics Lab

(Common with AN010 308 , PE010 308 and ME010 308)

Teaching scheme **Credits:** 2

3 hours practical per week

Objectives

- *To provide exposure to the actual flow process and various instruments adopted for flow measurement .*

- Study and acquire a thorough knowledge of the various pipe fittings and plumbing tools.
- Study the use of different types of taps, valves.
- Study the various measuring instruments like gauges, pitot tube, watermeters and current meters.
- Determination of metacentric height and radius of gyration of floating bodies.
- Determination of hydraulic coefficients of orifices and mouthpieces under constant head method and time of emptying method.
- Calibration of discharge measuring equipments in closed conduits like venturimeter, orificemeter, watermeter etc.
- Calibration of discharge measuring equipments in open channel flow like rectangular and triangular notches.
- Determination of Darcy's constant and Chezy's constant for pipe flow.
- Determination of critical velocity in pipe flow.
- Determination of minor losses in pipe flow.
- Experimental verification of Bernoulli's theorem.
- Determination of Chezy's constant and Manning's number for open channel flow.
- Calibration of Plug –Sluices.

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
30% - Viva voce

EN010401 Engineering Mathematics III

(Common to all branches)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives: *Apply standard methods of mathematical &statistical analysis*

MODULE 1 Fourier series (12 hours)

Dirichlet conditions – Fourier series with period 2 π and 2l – Half range sine and cosine series – Harmonic Analysis – r.m.s Value

MODULE 2 Fourier Transform (12 hours)

Statement of Fourier integral theorem – Fourier transforms – derivative of transforms- convolution theorem (no proof) – Parsevals identity

MODULE 3 Partial differential equations (12 hours)

Formation by eliminating arbitrary constants and arbitrary functions – solution of Lagrange's equation – Charpits method –solution of Homogeneous partical differential equations with constant coefficients

MODULE 4 Probability distribution (12 hours)

Concept of random variable , probability distribution – Bernoulli's trial – Discrete distribution – Binomial distribution – its mean and variance- fitting of Binominal distribution – Poisson distribution as a limiting case of Binominal distribution – its mean and variance – fitting of Poisson distribution – continuous distribution- Uniform distribution – exponential distribution – its mean and variance – Normal distribution – Standard normal curve- its properties

MODULE 5 Testing of hypothesis (12 hours)

Populations and Samples – Hypothesis – level of significance – type I and type II error – Large samples tests – test of significance for single proportion, difference of proportion, single mean, difference of mean – chi –square test for variance- F test for equality of variances for small samples

References

1. Bali& Iyengar – A text books of Engg. Mathematics – Laxmi Publications Ltd.
2. M.K. Venkataraman – Engg. Mathematics vol II 3rd year part A & B – National Publishing Co.
3. I.N. Sneddon – Elements of partial differential equations – Mc Graw Hill
4. B.V. Ramana – Higher Engg. Mathematics – Mc Graw Hill
5. Richard A Johnson – Miller Fread's probability & Statistics for Engineers- Pearson/ PHI

6. T. Veerarajan – Engg. Mathematics – Mc Graw Hill
7. G. Haribaskaran – Probability, Queueing theory and reliability Engg. – Laxmi Publications
8. V. Sundarapandian - probability ,Statistics and Queueing theory – PHI
9. H.C.Taneja – Advanced Engg. Mathematics Vol II – I.K.International
10. A.K.Mukhopadhyay-Mathematical Methods For Engineers and Physicists-I.K.International

EN010 402(ME): Principles of Management

(Common with EN010 502(ME))

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To develop an understanding of different functional areas of management.*
- *To understand the functions and duties an individual should perform in an organisation.*

Module I (12 hours)

Management Concepts: Vision, Mission, Goals and Objectives of management-MBO-Scientific management- Functions of management- Planning- Organizing- Staffing-Directing- Motivating- Communicating- Coordinating- Controlling- Authority and Responsibility- Delegation- Span of control- Organizational structure- Line, Line and staff and Functional relationship.

Module II (12 hours)

Personnel Management: Definition and concept- Objectives of personnel management-Manpower planning- Recruitment and Selection of manpower- Training and development of manpower- Labour welfare- Labour turnover- Quality circle- Industrial fatigue- Industrial disputes-Method of settling disputes- Trade unions.

Module III (12 hours)

Production management: Objectives and scope of production management- Functions of production department- production management frame work- product life cycle-Types of production- Production procedure- Project planning with CPM and PERT- Basic concepts in network.

Module IV (12 hours)

Financial Management: Objectives and Functions of Financial Management- Types of Capital- Factors affecting working capital- Methods of financing.
Cost Management: Elements of cost- Components of cost- Selling Price of a product.

Module V (12 hours)

Sales and Marketing Management: Sales management- Concept- Functions of sales department- Duties of sales engineer- Selling concept and Marketing concept- Marketing-Definition and principles of marketing- Marketing management and its functions- Sales forecasting- Pricing- Advertising- Sales promotion- Channels of distribution- Market research.

Text Books

1. Koontz and Weihrich, *Essentials of Management*, Tata McGraw Hill.
2. Mahajan M., *Industrial Engineering and Production Management*, Dhanpat Rai and Co.
3. Kemthose and Deepak, *Industrial Engineering an Management*, Prentice Hall of India.

Reference Books

1. Martand Telsang, *Industrial Engineering and Production Management.*
2. Khanna O.P., *Industrial Engineering and Management*, Dhanpat Rai and Co.
3. Philip Kotler, *Marketing Management*, Prentice Hall of India.
4. Sharma S. C. & Banga T. R., *Industrial Organisation and Engineering Economics*, Khanna Publishers.
5. Prasanna Chandra, *Financial Management*, Tata McGraw Hill.

AU010 403: Auto Power Plant

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of automotive engines*
- *To impart the Constructional details of engine components*

Module I (12 hours)

Introduction: Types of power plant, basic engine nomenclature, classification of I.C engines (Classification by cylinder arrangement, Valve arrangement and Type of valves). Working of two stroke and 4 stroke with relative merits and demerits. Firing order, Applications and merits of IC Engines.
Constructional details of engine components: Cylinders – types, cylinder liners, engine block, types of cylinder head, gasket materials, and piston - types, materials, piston rings, piston pins, connecting rod, crank shaft, flywheel, cam shaft, valve and valve mechanism, inlet and exhaust manifold construction, hydraulic tappets.

Module II (12 hours)

Two stroke engines: Principles of engine operation (SI & CI), Port timing diagrams, Symmetrical & unsymmetrical timing, Three port engine.
Theoretical Scavenging processes, Scavenging parameters, Comparison of Different Scavenging Systems; Cross flow, loop flow, uniflow, Pre blow down, Blow down. Scavenging pumps, blowers.
Relative merits & demerits of petrol, diesel engines in general. Advantages and disadvantages of diesel engines for two wheelers, power plant for electric bikes.

Module III (12 hours)

Valve and valve mechanism: Angle of seat, Operating Conditions, operating temperatures, valve cooling, Sodium cooled valves, Valve rotators, valve seats, valve guides, , valve springs, valve clearance, valve timing, OHV, OHC,DOHC, V-TEC valve systems. Valve train component details, Camshaft,-drives of cams, cam types, tappets, push rods, rocker arms & rocker Shaft.
Intake system components, Discharge coefficient, Pressure drop, Air filter, Intake manifold, connecting pipe. Exhaust system components, Exhaust manifold and exhaust pipe, Spark arresters, Waste heat recovery, Exhaust mufflers, Type of mufflers.

Module IV (12 hours)

Fuel supply system in petrol engines: Types of fuel feed systems, fuel tank, fuel pumps and fuel filters (types and construction), air filter types. Carburetion, simple carburettor, different circuits in carburettor, types of carburettor (Solex,SU,Carter only).Comparison between GDI, MPFI and carburettor system.
Fuel supply system in diesel engines: Cleaning system, transfer system, injection pump, their functions and necessity, simple and multi unit pump, CAV Bosch pump, maximum and minimum speed governors, injection nozzles and types of nozzles. Heavy duty air filters, diesel filters, cold starting devices.

Module V (12 hours)

Cooling system: Necessity of cooling, types of cooling including forced cooling, thermostat, water pump, radiator, antifreeze solution, oil cooling. Temperature gauges.
Lubricating system: Function and types of lubrication systems, classification and properties of lubricants, service ratings of oils, oil filter, oil pumps, crank case ventilation, oil additives, and specification of lubricants. pre-lubrication systems, effect of engine conditions on lubricating oil, consumption of lubricating oil, Oil pressure warning system, oil pressure gauges.

Text Books

1. Kirpal Singh – Automobile Engineering Volume 1 & 2 standard publications, New Delhi.
2. T. R. Banga and Nathu Singh – Text book on Automobile Engineering, Khanna Publishers, New Delhi.
3. Gupta R.B , Automobile Engineering , Satya Prakashan

Reference Books

1. Newton K / Steeds W / Garrett T.K – Motor Vehicle, Butterworth Heinemann Ltd
2. William H Crouse / Donald L Anglin, Automotive Mechanics , Tata McGraw-Hill Publishers
3. Joseph Heitner- Automobile mechanics, CBS Publishers, New Delhi
4. A. W. Judge – Modern petrol engine, Chapman and hall, London.
5. P. M. Heldt – High speed diesel engines, Chillon Co. New York.
6. I.C.Engines by Taylor, MIT Press England
7. I.C.Engines By Lichty., McGraw Hill
8. Fuels & Combustion By Smith & Stinson., McGraw-Hill

AU010 404: Manufacturing Process

(Common with ME010 404)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

1. *To gain theoretical and practical knowledge in material casting processes and develops an understanding of the dependent and independent variables which control materials casting in a production processes.*
2. *Provide a detailed discussion on the welding process and the physics of welding. Introduce students to different welding processes weld testing and advanced processes to be able to appreciate the practical applications of welding.*
3. *The course will also provide methods of analysis allowing a mathematical/physical description of forming processes.*

Module I (12 hours)

Patterns: - types, allowances, color code – Molding sand**:-** constituents, types, properties, testing, types of mould, molding machines – Cores**:-** sands, types prints, machines, chaplets, forces acting on molding flasks - Gating system**:-** fluid flow and heat transfer in metal casting, elements and design of gating system, sprue, gating ratio, slag trap system – Risering:- risering design, chills, feeding devices - Cupola operation -pouring and cleaning of castings - defects in castings - inspection and quality control - Casting**:-** continuous, strip, shell mold, vacuum, investment, slush, pressure, die, centrifugal, precision investment, squeeze casting and semi solid metal forming, economics and surface finish obtainable - casting machines - comparison of casting with other production processes. (Include necessary figures and equations).

Module II (12 hours)

Welding**:-** diffusion, definition of welding, metallurgy of welding, applications, classification, mechanism - welding design:- effect of weld parameters on weld quality, heat input, heat flow and distortions - Gas welding:- details, equipment, fluxes and filler rods – flame cutting - Arc welding:- applications, equipment, polarity, governing factor in fusion welding - electrodes and types – TIG - GMA - CO_2 process - Submerged arc, electroslag, plasma arc and flux cored arc welding - Resistance, thermit solid state welding - Electron and laser beam welding – explosive welding - inspection and defects in welding - heat affected zone, grain size variations in joint strength - Brazing and soldering - adhesive bonding – Extrusion**:** Metal flow – mechanism and types – extrusion defects.

Module III (12 hours)

Rolling**:-** principles - types of rolls and rolling mills - mechanics of flat rolling, roll pressure distribution - neutral point - front and back tension, roll forces in hot rolling, roll torque and power, friction, deflection and flattening - friction and lubrication in metal forming - defects - hot and cold rolling - rolling machines - strip velocity and roll velocity - roll and roll pass design - theories of rolling and effect of parameters - load calculation - rolling of tubes, wheels, axles, I-beam thread, gear rolling.

Module IV 12 hours)

Forging**:-** classification - open die forging, forces and work of deformation - Forging methods analysis:- slab method only, solid cylindrical, rectangular work piece in plane strain, forging under sticking condition - deformation zone geometry – die forging:- impression, close,

coining, skew rolling etc. – defects in forging – forgeability tests – die design and materials – equipments - heating in forging - quality assurance for forging -non destructive testing - mechanics of rod and wire Drawing:- ideal deformation, ideal deformation and friction, drawing of flat strips etc – drawing defects – drawing practices.

Module V (12 hours)

Locating methods:- methods, degrees of freedom - principle of clamping:- clamping types - work holding principle – Die cutting:- Different types - shearing - types of presses –cutting action in punch and die operations – die clearances – types of die:- progressive, compound, combination die – Bending dies:- bending methods, minimum bend radius, bendability, spring back, forces, bend allowances – Forming dies:- solid form, curling, embossing, coining, bulging dies - Shear and tube spinning - High energy rate forming**:-** need, energy sources - material behavior - pneumatic, mechanical, electrohydraulic, electromagnetic, and explosive forming – Deep drawing:- deep drawability, punch forces.

Text Books

1. Manufacturing Science - Amitabha Ghosh and Ashok Kumar Mallick
2. Manufacturing Engineering and Technology - Kalapakjian and Schmid

Reference Books

1. Principles of Metal Casting - Hine and Rosenthal
2. Foundry Technology - P.R.Beeley

AU010 405: Machine Drawing

(Common with PE010 405 and ME010 405)

Teaching scheme **Credits:4**

3 hours practical and 1 hour theory per week

Objectives :

- *To impart the fundamental concepts of machine drawing.*
- *To develop primary knowledge of working drawings.*
- *To produce orthographic drawing of different machine parts.*
- *To develop skill to produce assembly drawings.*
- *To develop skill to produce detailed drawings of machines parts from assembly drawing.*

Module-1(15hrs)

Conversion of pictorial views into orthographic views-dimensioning techniques-preparation of drawing- - Limits and tolerances of machine parts - Hole system and shaft system of tolerances - Designation of fundamental deviation - Types of fits and their selection - Indication of dimensional tolerances and fits on simple machine parts - Geometrical tolerances – Recommended symbols - Indication of geometrical tolerances on simple machine parts - Surface roughness – Indication of surface finish on drawings - Preparation of shop floor drawings of simple machine parts.

Types of screw threads-different forms-conventional representation-sketching orthographic views of hexagonal bolts and nuts -dimensional drawing-square headed bolts and nuts –sketching of different types of lock nuts and locking devices- foundation bolts.

Forms of rivet heads – riveted joints-lap and butt joints with single and multiple riveting in chain and zig – zag arrangements –dimensional drawing. Sketching of conventional representation of welded joint.

Module-2 (20 hrs)

Fully dimensioned and sectional drawing of the following Joints-

knuckle joint-jib and cotter

shaft couplings-types of keys- protected types of flanged couplings-bushed pin type flexible coupling-Oldham's coupling

Pipe joints-spigot and socket joint-flanged joint-

Shaft bearings and support-Plummer block IC engine parts-piston-connecting rod

Module-3(25hrs)

Assembly and working drawings of the followingValves

-stop valve-spring loaded safety valve –dead weight safety valve-feed check valve-feed check valve

Machine elements-screw jack –lathe tool post-spindle-tailstock

Note:

- Drawing practical classes have to be conducted by using any standard CAD software and using drawing instruments in alternate weeks (3Hours) preferably for each half of the student.

  Semester End examination (3Hours) shall be conducted by using drawing instruments only
- All drawing exercises mentioned above are for class work. Additional exercises wherever necessary may be given as homework
-

References:

1. N.D.Bhatt and Panchal, *Machine Drawing*, Charator Publishing House
2. P I.Varghese, *Machine Drawing*, VIP Publishers, Thrissur
3. Ajeet Singh, *Machine Drawing*, Tata McGraw Hill Education Private Ltd
4. P.S.Gill , *Machine Drawing*, S.K.Kataria &Sons

University examination pattern

Question I: One questions of 10 marks from module-1

Question II: One questions of 30 marks out of 2 questions from module-2.

Question III:One question of 60 marks from module-3

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AU 010 406(EE) Electrical Technology

(Common with ME010 406 (EE) and PE010 406 (EE))

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

Understanding the basic working principles of DC machines Ac machines and its drives

Module I (8 hours)

D.C. Generator - O.C.C. – Condition for self excitation – field critical resistance – critical speed - Load characteristics of generators- Losses- power flow diagram- efficiency- condition for maximum efficiency- Application.

Module II (16 hours)

D.C. Motors**:** Back emf – speed and torque equation- starting and speed control – testing of D.C. Motors – brake test – Swinburn's test- Performance characteristics of Shunt, Series and Compound motors. - Applications

Transformer – Emf equation: No load current – equivalent circuit – regulation- efficiency. Determination of regulation and efficiency from O.C. and S.C. tests – cooling of transformer. Basic principle of 3 phase transformer - Applications

Module III (13 hours)

Alternators - Construction details**:** Type – emf equation (winding factor need not be derived) – synchronous impedance – regulation by emf and mmf method.

Synchronous Motors**:** Principle of operation – method of starting.

Three phase induction motor: Production of rotating magnetic field - equivalent circuit – torque equation – torque slip characteristics – no load and blocked rotor tests – starting and speed control – Application

Single Phase motor: Different types - Application.

Module IV (13 hours)

Industrial drives – electric drives – advantages – individual drive and group drive – factors affecting choice of motor – mechanical characteristics of a.C. and D.C. motors – motors for particular application like textile mill, steel mill, paper mill, mine, hoists, crane etc. – size and rating of motor . Electric traction – Different systems of traction – comparison – track electrification – different systems – traction motor characteristics – electric braking – plugging – Dynamic and regenerative braking.

Module V (10 hours)

Power semiconductor devices: power diodes – SCR's - principle of operation of SCR's – two transistor analogy of SCR – characteristics – SCR rating (basic principle only). High frequency heating – induction and dielectric heating – resistance heating resistance welding- block schematic of resistance welding scheme.

Text Books

1. Dr. P S Bimbra, *Electrical Machinery*, Khanna Publishers
2. J B Gupta, *Electrical Machines* , S K Kataria and Sons
3. Dr. P S Bimbra, *Power Electronics*, Khanna Publishers

Reference Books

1. Alexander Langsdorf A S: Theory of AC Machinery, Mc-Graw Hill
2. Say M G: Performance and design of AC Machines, ELBS
3. Electrical machines, Drives and Power Systems: Thoedore Wildi, Pearson Ed.
4. P.C. Sen, *Thyristor DC Drives*, Wiley-Interscience Publication 1984
5. Joseph Vithayathil, *Power Electronics-Principles and applications*, TMH, 2010
6. B. K. Bose, Modern Power Electronics and A.C. Drives, PHI, 2002.
7. G.K. Dubey, *Fundamentals of Electrical Drives*, Narosa Publishing House, New Delhi,2005

AU010 407: Automobile Workshop I

Teaching scheme **Credits:** 2
3 hour practical per week

Study

1. Study of hand tools, special purpose tools, sketching and it's uses
2. Writing technical specifications and description of all types of chassis and transmission components of automobiles, including body and interiors (two wheeler, four wheeler and heavy vehicle – one each)

Experiments

1. Servicing of clutch assembly, checking the spring tension of coil springs in spring tester.
2. Dismantling of gear box, inspecting components, servicing, checking the gear ratios.
3. Dismantling of differential assembly, servicing, backlash adjustments, check for drive axis ratio.
4. Servicing of A. C. mechanical fuel pump and testing the pump.
5. Servicing of Carburetor, Study Various Circuits on it, tuning of carburetor.
6. Servicing master and wheel cylinders in hydraulic brake system & bleeding of brakes.
7. Valve timing setting including valve clearance adjustment.
8. Servicing of steering gear box, checking for end play in shafts.
9. Overhauling of a complete strut type suspension system.
10. Dismantle and assemble C.V joint. Also examine a slip joint, U.J cross in propeller shaft.
11. Compression test of petrol and diesel engine.
12. Disassembling cylinder head, decarbonizing , Valve Seat Grinding
13. Disassembling of engine: inspection of engine components, servicing of components, measurement of dimensions of different components of engine, compare with standard specifications, piston ring setting, assembling using special tools.
14. Dismantling of gear box, inspecting components, servicing, checking the gear ratios.
15. Rectifying the troubles in ignition system, adjusting spark plug and C. B. Point gap, checking ignition timing.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Internal Practical examination at the end of semester
20% - viva
20% - Rough record & fair record
20% - Regularity in the class

University Examination Pattern *(Maximum Marks-100)*

20% - Initial Write Up (Aim, Tools Required, Materials Required, Theory, Procedure)
40% - Performance in Test
20% - Viva
10% - Result / Inference
10% - Rough record & Fair Record

AU010 408 STRENGTH OF MATERIALS LAB

(Common with ME010 408 and PE010 307)

Teaching scheme **Credits: 2**

3 hours practical per week

Objective: *To study properties of various materials*

List of Experiments

1. Tests on springs (open and close coiled)
2. Bending Test on Wooden Beams using U. T. M.
3. Verification of Clerk. Maxwell's Law of reciprocal deflection and Determination of Youngs modulus'E 'for steel.
4. Torsion Pendulum (M.S. wires. Aluminum wires and brass wires)
5. Tension test using U. T. M. on M. S. Rod, torsteel and High Tensile steel.
6. Torsion Test on M. S. Rod.
7. Shear Test on M.S. Rod.
8. Fatigue Test
9. Impact Test (Izod and Charpy)
10. Hardness Test (Brinell, Vicker's and Rebound)
11. Strut Test.

Note

All tests should be done as per relevant BIS.

References

1. Timoshenko.S.P, Strength of Materials, Part-1, D.Van Nostrand company, Inc.Newyork.
2. Bansal R.K., Strength of Materials, Lakshmi Publications, New Delhi.
3. Bhavikatti S.S , Strength of Materials, Vikas Publishing House (P) Ltd.
4. D.S. Prakash Rao, Strength of Materials, Vol. I, University Press (India) Ltd.
5. Popov E.P., Engineering Mechanics of solids, Prentice Hall of India, New Deihi.
6. Punmia B.C, Strength of Materials and Mechanics of structures, Vol.1, Lakshmi Publications, New Delhi.

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
30% - Viva voce

EN010501A ENGINEERING MATHEMATICS IV

(Common to all branches except CS & IT)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives: *Use basic numerical techniques to solve problems and provide scientific techniques to decision making problems.*

MODULE 1 Function of Complex variable (12 hours)

Analytic functions – Derivation of C.R. equations in cartision co-ordinates – harmonic and orthogonal properties – construction of analytic function given real or imaginary parts – complex potential – conformal mapping of z^2 , $\frac{1}{z}$ - Bilinear transformation – cross ratio – invariant property (no proof) – simple problems

MODULE 2 Complex integration (12 hours)

Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's series- Laurent's series – Zeros and singularities – types of singularities – Residues – Residue theorem – evaluation of real integrals in unit circle – contour integral in semi circle when poles lie on imaginary axis.

MODULE 3 Numerical solution of algebraic and transcendental equations (10 hours)

Successive bisection method – Regula –falsi method – Newton –Raphson method - Secant method – solution of system of linear equation by Gauss – Seidel method

MODULE 4 Numerical solution of Ordinary differential equations (10 hours)

Taylor's series method – Euler's method – modified Euler's method – Runge – Kutta method (IV order) - Milnes predictor – corrector method

MODULE 5 Linear programming problem (16 hours)

Definition of L.P.P., solution, optimal solution, degenerate solution – graphical solution –solution using simplex method (non degenerate case only) Big -M method – Duality in L.P.P. – Transportation problem –Balanced T.P. – initial solution using Vogel's approximation method - modi method (non degenerate case only)

References

1. B.V. Ramana – Higher Engg. Mathematics – Mc Graw Hill
2. M.R.Spicgel , S.Lipschutz , John J. Schiller, D.Spellman – Complex variables, schanm's outline series - Mc Graw Hill
3. S.Bathul – text book of Engg.Mathematics – Special functions and complex variables –PHI
4. B.S. Grewal – Numerical methods in Engg. and science - Khanna Publishers
5. Dr.M.K Venkataraman- Numerical methods in science and Engg -National publishing co

6. S.S Sastry - Introductory methods of Numerical Analysis -PHI
7. P.K.Gupta and D.S. Hira – Operations Research – S.Chand
8. Panneer Selvam– Operations Research – PHI
9. H.C.Taneja – Advanced Engg. Mathematics Vol II – I.K.International

AU010 502 Computer Aided Design & Manufacturing

(Common with PE010 604 and ME010 502)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide a comprehensive concepts of the design aspects and its importance in computer assisted design and manufacture.*
- *To examine technologies those have been developed to automate manufacturing* operations.

Module 1 (12 hours)

Evolution of CAD/CAM and CIM, computers and workstation, elements of interactive graphics, input/ out put display, storage devices in CAD, – networking of CAD systems - 2D Graphics: line drawing algorithms, DDA line algorithm – circle drawing, bressnham`s circle drawing algorithm– 2D Transformation: translation, rotation, scaling, reflection – clipping -3D Graphics (basic only).

Module 2 (12 hours)

Geometric modeling: Wire frame, surface and solid modeling - Engineering analysis; design review and evaluation, automated drafting.

Numerical control: Need - advantages and disadvantages – classifications – Point to point, straight cut and contouring positioning - incremental and absolute systems – open loop and closed loop systems – DDA integrator and Interpolators – resolution – CNC and DNC.

Programmable Logic Controllers (PLC)**:** need – relays - logic ladder program – timers, simple problems only - Devices in N.C. systems: Driving devices - feed back devices: encoders, moire fringes, digitizer, resolver, inductosyn, and tachometer.

Module 3 (12 hours)

NC part programming: part programming fundamentals - manual programming – NC co-ordinate systems and axes – tape format – sequence number, preparatory functions, dimension words, speed word, feed world, tool world, miscellaneous functions – programming exercises.

Computer aided part programming: concept and need of CAP – CNC languages – APT language structure: geometry commands, motion commands, postprocessor commands, compilation control commands – programming exercises – programming with interactive graphics.

(At least one programming exercise should be included in the University examination)

Module 4 (12 hours)

Computer Aided Process Planning (CAPP): concepts; traditional and CAPP; automated process planning: process planning, general methodology of group technology, code

structures of variant and generative process planning methods, AI in process planning, process planning software.
Flexible Manufacturing Systems (FMS): Introduction, types, concepts, need and advantages of FMS - cellular and FMS - JIT and GT applied to FMS.

Module 5 (12 hours)

Robot Technology**:** overview, basic components - robot end effectors – sensors in robotics – control of actuators in robotic mechanisms (basic only) – control of robo joint, stepper motor, direct drive actuators – hydraulic and pneumatic systems (basic only) – robot arm kinematics, direct and inverse kinematics solution robot arm dynamics – robot applications: material transfer, machine loading and unloading, pre cutting operations, assembly, inspection and welding.

TEXT BOOKS:

1. Newman and Sproull - Principles of interactive Graphics, McGraw – Hill.
2. Yoram Koren - Numerical control of machine tools, McGraw-Hill.

REFERENCE BOOKS:

1. Craig John - Introduction to Robotics
2. Groover M.P. - CAD/CAM, PHI.
3. Hearn and Baker - Computer graphics (in C version), Prentice Hall.
4. Petruzella Frank.D. - Programmable logic controllers.
5. Jonn Craig - Introduction to Robotics

AU010 503: Auto Chassis

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objective

- *To familiarize the students with the fundamentals of Automobile Chassis.*
- *Students will be able to know the basics of Automobile Chassis Components and Construction &Working principle of Front Axle, Rear Axle, Wheels, Tyres, Final Drive, Steering System, Brakes and Suspension System.*

Module I (8 hours)

Introduction: General consideration relating to chassis layout, types of automobiles, layout of an automobile with reference to power plant. Relative merits & demerits of different layouts. Components and Description of an automobile.
Frames: Types of frames-Conventional, Semi integral, Integral, Frame Sections, Sub frames, materials, cross members and x members, Defects in Chassis Frame, Testing of frames. Unitised frame body construction: Loads acting on vehicle frame.

Module II (14 hours)

Front axle and steering: Introduction to front axle, construction, classification-live, dead, Stub axle types.
Steering system- parts , functions, working and description, different types of steering gears and their construction, Steering linkages- conventional steering linkage, linkage for independent front suspension, power steering, under steering and over steering effects. Wheel condition for true rolling ,Steering Mechanisms- Ackermann and Davis steering gear, Steering ratio, Steering geometry- castor, camber, king pin inclination, toe in, toe out, Wheel alignment

Module III (12 hours)

Suspension: Objectives, basic considerations, classification and elements of suspension system, types and description of suspension springs, leaf springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows, pneumatic suspension, hydro elastic suspension, constructional and working details of telescopic shock absorbers. Types of independent suspension and its comparison with rigid axle suspension function of stabilizer bar.
Drive line: Torque reaction, driving thrust, Hotch kiss drive, torque tube drive, propeller shaft, critical speeds, universal joints, types, Front wheel drive, differential action, constructional details, differential lock, limited slip differential, axle housing, types, construction, Construction details of multi drive axle vehicles, double reduction.

Module IV (14 hours)

Brakes: Functions, requirements of good braking system, principle of braking, stopping times and distance, braking efficiency, weight transfer, brake shoe theory, self energization, determination of braking torque.
Classification and working of brakes on different considerations- purpose, construction, actuation, braking effort, and locations (disc, drum, band, hydraulic brakes, mechanical brakes, air brakes, electric brake, servo brakes, power assisted brakes, fail safe brakes, exhaust brakes, parking brakes, hill holding brake, vacuum boosted hydraulic brakes layout and details of components).

Master & wheel cylinders, bleeding of brakes, brake drums, brake linings, brake fluid, factors influencing operation of brakes such as operating temperature, lining, brake clearance, pedal pressure, and linkages, Antilock Braking System (ABS).

Module V (12 hours)

Wheels and tires: Requirement of good wheel, types and construction of wired, disc and alloy wheel, wheel dimensions. Tire types and construction, bias, radial and belted ply comparisons, treaded patterns, inflation pressure and its effects, static and dynamic properties of pneumatic tires, aspect ratio, factors affecting tire performance and life, tire retreading, tire rotation, tubeless tire and its merits, different tire specifications, desirable properties of tires.

Text Books

1. Kirpal Singh – Automobile Engineering Volume 1 & 2 standard publications, New Delhi.
2. Gupta R.B , Automobile Engineering , Satya Prakashan
3. Giri NK - Automobile Technology- Khanna Publishers

Reference Books

1. Newton K / Steeds W / Garrett T.K – Motor Vehicle, Butterworth Heinemann Ltd
2. William H Crouse / Donald L Anglin, Automotive Mechanics , Tata McGraw-Hill Publishers
3. Joseph Heitner- Automobile mechanics, CBS Publishers, New Delhi
4. N. K. Giri – Automobile mechanics – Khanna Publishers.

AU010 504: Kinematics of Machinery

(Common with ME010 504)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

1. *To understand the basic components and layout of linkages in the assembly of a system/machine.*
2. *To understand the principles involved in assembly the displacement, velocity and acceleration at any point in a link of a mechanism.*
3. *To understand the motion resulting from a specified set of linkages.*
4. *To understand and to design few linkage mechanisms and cam mechanisms for specified output motions.*
5. *To understand the basic concepts of toothed gearing and kinematics of gear trains.*

Module I (14hours)

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law –Kinematic inversions of four-bar chain, slider crank chains and double slider crank chains – Limit positions –Mechanical advantage – Transmission Angle -Coupler curves – Description of some common Mechanisms – Quick return mechanisms, Straight line generators, Dwell Mechanisms, Ratchets and Escapements, Universal Joint, steering mechanisms

Module II (12hours)

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method – Velocity and acceleration polygons – Velocity analysis using instantaneous centers – Kennedy's theorem, kinematic analysis by complex algebra methods – Vector approach – Computer applications in the kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration.

Module III (10hours)

Kinematic synthesis (Planar Mechanisms) - Tasks of kinematic synthesis – Type, Number and dimensional synthesis – Precision points - Graphical synthesis for four link mechanism Function generator – 2 position and 3 position synthesis – Overlay Method - Analytical synthesis techniques

Module IV (12 hours)

Cams and Followers: - types-follower motion-SHM-uniform velocity and acceleration-Cycloidal - displacement, velocity and acceleration curves-Cam profile-Reciprocating and oscillating followers-Tangent cams-Convex and concave cams with footed followers. Introduction to Polynomial cams.

Module V (12 hours)

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting – Non-standard

gear teeth – Helical, Bevel, Worm, Rack and Pinion gears [Basics only] Gear trains – Speed ratio, train value – Parallel axis gear trains– Epicyclic Gear Trains – Differentials

Reference Books

1. R L Norton, Kinematics and Dynamics of Machinery, 1st ed., *Tata McGraw Hill Education Private Limited*, Delhi, 2009
2. J. E. Shigley, J. J. Uicker, *Theory of Machines and Mechanisms*, McGraw Hill
3 S .S Rattan Theory of Machines, 3rd ed., *Tata McGraw Hill Education Private Limited*, Delhi, 2009
4 A. Ghosh, A. K. Malik, *Theory of Mechanisms and Machines*, Affiliated East West Press
5 A. G. Erdman, G. N. Sandor, *Mechanism Design: Analysis and synthesis Vol I & II*, Prentice Hall of India

AU010 505 I. C. Engines & Combustion

(Common with ME010 505)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of IC Engine and Combustion*

Module I (15 hours)

Working of two stroke and four stroke engines and valve timing diagrams of – Petrol and diesel engine. (Review only). Fuel air cycles. Ignition systems- Battery and magneto systems- ignition timing and spark advance. Fuels – Qualities, rating of fuels - Octane and Cetane numbers. Alternative fuels.

Types of engines - Wankel engine,- Stirling engine - Stratified charge engine - VCR engine - free piston engine.

Module II (15 hours)

Air fuel mixture requirements – Solex Carburettor. Stoichiometric and excess air calculations. Fuel injection systems in SI and CI engines - Fuel injection pumps.- nozzle- direct and indirect injections. MPFI systems and GDI engines. CRDI technology.

Lubrication systems- types – properties of lubricants. Flash point, fire point and viscosity index.

Module III (10 hours)

Thermodynamics of combustion. Combustion reaction of common fuels. Exhaust gas composition. Flue gas analysis. Air fuel ratio from exhaust gas composition. Variation of specific heats- heat losses- Dissociation.

Engine cooling systems- Air and liquid system- Super charging and turbo charging

Module IV (10 hours)

Combustion in SI engines- P-θ diagram- Stages of combustions- Ignition lag. Flame propagation – Abnormal combustion – detonation effects. Combustion in CI engines, P-θ diagram - Ignition delay, diesel knock- controlling methods.

Air motion- Squish, tumble, swirl motions. Different types combustion chamber for SI and CI engines.

Module V (10 hours)

Pollutants in SI and CI engines. NOx, CO, unburned hydrocarbons ,smoke and particulate. Measurement of exhaust emission. (HC, CO, NOx and smoke intensity) Exhaust gas treatment.- Catalytic converter – Thermal reaction -Particulate trap.

Testing of IC engines - Indicated power – Brake Power - Volumetric efficiency - Heat balance test - Morse test.

Text Books

V Ganesan, *Internal Combustion Engine* Tata Mc Graw Hill Publishing Company Ltd. New Delhi 2006. -

Reference Books

John B Heywood, Internal Combustion Engine Fundamentals, Mc Graw Hill Publishing Company Sigapur,1998.

Obert E F,Internal Combustion Engine and air Pollution Mc Graw Hill book company New York.

Mathur and Sharma,A course in Internal Combustion Engine - Dhanpat Rai Publications new Delhi, 2004.

Sharma S.P, Fuels and Combustion, Tata Mc Graw Hill Publishing Company Ltd. New Delhi.1990.

Spalding D.B. Some Fundamentals of Combustion Better Worths Scientific Publications London, 1955.

AU010 506 Thermodynamics

(Common with PE 010 506 and ME010 506)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of Thermodynamics*

Pre-requisites: *Knowledge required to study this subject (especially any subject previously studied)*

Module I (10 hours)

Fundamentals concepts – scope and limitations of thermodynamics. Thermodynamic systems – different types of systems – macroscopic and microscopic analysis – continuum – Properties – state – processes. Thermodynamics equilibrium – Equation of state of an ideal gas – PVT system – Real gas relations – Compressibility factor – Law of corresponding states.

Module II (15 hours)

Laws of thermodynamics- Zeroth law of thermodynamics – Thermal equilibrium – Concept of temperature – Temperature scales – Thermometry – Perfect gas temperature scales. – Thermometry – Perfect gas temperature scales. Work and heat – First law of thermodynamics – Concept of energy _ First law for closed and open systems – Specific heats – internal energy and enthalpy – Steady flow energy equations _ Jule Thompson effect.

Module III (15 hours)

Second law of thermodynamics- Various statements and their equivalence_ Reversible process and reversible cycles- Carnot cycles- Corollaries of the second law – thermodynamics temperature scales – Clausis inequality- Concept of entropy – Calculation of change in entropy in various thermodynamic processes – Reversibility and irreversibility – Available and unavailable energy – Third law of thermodynamics.

Module IV (10 hours)

Thermodynamic relations – Combined first and second law equations – Hemholtz and gibbs functions – Maxwell relations- Equations for specific heats, internal energy, enthalpy and entropy – Clausius Clapeyron equations _ applications of thermo dynamic relations.

Module V (10 hours)

Properties of pure substances – PVT, PT and TS diagrams, Mollier diagrams- Mixture of gases and vapours- mixture of ideal gases – Dalton's law – Gibbs law- Thermodynamic properties of mixtures

Text Books

1 P K Nag, *Engineering Thermodynamics*, Tata Mc Graw Hill Publishing Company Ltd. New Delhi 2008.

Reference Books

1. J. F. Lee and FW Sears, *Engineering Thermodynamics,* Addison-Wesleg Publishing Company, London, 1962.
2. Spalding and Cole, *Engineering Thermodynamics,* The English Language Book Society and Edward Arnold Ltd.,1976.
3. M. A.chuthan, *Engineering Thermodynamics*,Prentice Hall of India Private Ltd, New Delhi 2002.
4. J.H Keenan, *Thermodynamics,* John Wiley and Sons , New York, 1963.
5. Edward F Obert, *Concept of Thermodynamics,* McGraw Hill book company New York, 1988.
6. J.P. Holman, *Thermodynamics,* McGraw Hill book company New York, 1988.
7. Mark W. Zemansky, *Heat and Thermodynamic*, McGraw Hill, New Delhi, 2001.
8 Roy T, *Basic Engineering Thermodynamics,* Tata Mc Graw Hill Publishing Company Ltd. New Delhi 1989.

AU010 507: Computer Graphics & Drafting

Teaching scheme **Credits:** 2
3 hour practical per week

Modeling – Introduction. Development of 2D and 3D geometric modeling using anyone parametric software. Exercises on automotive components - 3D modelling
Software's – Pro-E, CATIA, UNIGRPHICS, Solid works etc.

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

Note: Exercise in Rapid prototyping may be demonstrated for the entire batch

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, modeling steps, results
30% - Viva voce

AU 010 508 Electrical & Electronics Lab

(Common with ME010 508 and PE010 508)

Teaching scheme **Credits:** 2

3 hours practical per week

Objectives

- *To conduct various tests on Electrical Machines and to study their performance.*
- *To conduct various tests on practical electronic circuits*

PART A

1. Study of 3-point and 4-point starters for D.C machines

2. OCC of self excited D.C machines – critical resistances of various speeds. Voltage built-up with a given field circuit resistance. Critical speed for a given field circuit resistance

3. OCC of separately excited D.C machines

4. Load test on shunt generator – deduce external, internal and armature reaction characteristics.

5. Load test on compound generator

6. Swinburne's test on D.C machines

7. Brake test on D.C shunt motors and determination of characteristics.

8. Brake test on D.C series motors and determination of characteristics.

9. Brake test on D.C compound motors and determination of characteristics.

10. O.C and S.C tests on single phase transformers – calculation of performance using equivalent circuit – efficiency, regulation at unity, lagging and leading power factors.

11. Load test on single phase transformers.

12. Alternator regulation by emf and mmf methods

13. Study of starters for three phase induction motors

14. Load tests on three phase squirrel cage induction motors

15. Load tests on three phase slip ring induction motors

16. Load tests on single phase induction motors

PART B

1. Design and testing of clipping and clamping circuits

2. Design and testing of of RC integrator and differentiator circuits.

3. Design and testing of rectifier circuits – Half wave – Full wave (centre – tapped and bridge) circuits. Filter circuits.

4. Design and testing of RC coupled amplifier– frequency response.
Sweep circuits

5. Design and Testing of RC phase-shift Oscillator

References

1. Dr. P S Bimbra, *Electrical Machinery*, Khanna Publishers
2. R K Rajput, *A text book of Electrical Machines*, Laxmi publishers
3. A.P. Malvino, *Electronic Principles*– TMH
4. Floyd, *Electronic Devices*, Pearson Education, LPE

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
30% - Viva voce

AU010 601 Mechanics of Machines

(Common with ME010 601)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- To understand the method of static force analysis and dynamic force analysis of mechanisms
- To understand the principles of governors and gyroscopes.
- To understand the design of flywheel
- To understand the working of different types of brakes and dynamometers

Module I (14 hours)

Force analysis of machinery - static and dynamic force analysis of plane motion mechanisms - graphical method - principle of superposition –matrix methods - method of virtual work.

Module II (12 hours)

Governors: - terminology; Watt, Porter, Proel, Hartnell, Hartung, Wilson-Hartnell, and Pickering governors-spring controlled governors of gravity type-effort and power-controlling force diagram-quality of governors-effect of friction-insensitiveness-stability-inertia governors- governor speed, torque characteristics of an engine-governor and flywheel.

Module III (12 hours)

Turning moment diagram and Flywheel: - coefficient of fluctuation of energy and speed- energy saved in a flywheel-punching press-dynamically equivalent two mass system-centre of percussion-kinetic equivalence-reversed effective force analysis-piston effort-crankpin effort- crank effort-turning moment diagrams for I.C. engines.

Module IV (10 hours)

Gyroscope: - Principle-Angular acceleration-Effect of gyroscopic couple on bearings, airplanes, and ships-stability of automobile and two wheel vehicles-Gyroscopic stabilization of sea vessels and grinding mills-Rigid disc at an angle fixed to a rotating shaft

Module V (12 hours)

Brakes and clutches: Shoe, double block, long shoe, internally expanding shoe, band, band & block, hydraulic, mechanical, air and power brakes-braking of a vehicle-cone, single plate, multiple, centrifugal clutches.
Dynamometers: Pony brake. rope brake, epicyclic train, belt transmission and torsion dynamometers-effort and power.

Reference Books

1. R L Norton, Kinematics and Dynamics of Machinery, 1st ed., *Tata McGraw Hill Education Private Limited*, Delhi, 2009
2. J. E. Shigley, J. J. Uicker, *Theory of Machines and Mechanisms*, McGraw Hill
3 S .S Rattan Theory of Machines, 3rd ed., *Tata McGraw Hill Education Private Limited*, Delhi, 2009
4 A. Ghosh, A. K. Malik, *Theory of Mechanisms and Machines*, Affiliated East West Press
5. C. E. Wilson, P. Sadler, *Kinematics and Dynamics of Machinery*, 3rd edition, Pearson Education.
6. Holowenko, Dynamics of Machinery, John Wiley

AU010602: Heat and Mass Transfer

(Common with ME010 602)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide a useful foundation and basic knowledge of the subject required for innovative work and advanced studies.*
- *To motivate the students and to develop interest in the subject by providing information along with practical application of different formulae from an engineering point of view.*

Module I (12 hours)

Scope and application of heat transfer principles in engineering practice. Introduction to basic modes of heat transfer

Conduction: Fourier law-thermal conductivity of solids, liquids and gasses-factors affecting thermal conductivity-common conducting and insulating materials. General heat conduction equation in Cartesian, cylindrical and spherical co-ordinates- one dimensional steady state conduction with and without heat generation-conduction through homogeneous and composite surfaces-plane wall, cylinders and spheres-concept of thermal resistance-contact resistance-variable thermal conductivity-critical thickness of insulation-overall heat transfer coefficient-heat transfer through corners and edges-conduction shape factor.

Module II (12 hours)

Convection: Elementary ideas of hydrodynamic and thermal boundary layers-Newton's law of cooling-factors affecting heat transfer coefficient in forced and natural (free) convection heat transfer-application of dimensional analysis to free and forced convection-significance of Prandtil number, Reynold's number, Grashof number and Nusselt number. Forced convection: Laminar and turbulent flow heat transfer in a circular pipe- Laminar and turbulent flow heat transfer in flow over a flat plate-flow across a cylinder. Natural convection: Natural convection heat transfer from a plate kept vertical and horizontal- cylinder kept vertical and horizontal-description of natural convection heat transfer from enclosed spaces. (Problems limited to using important empirical relations available in data book)

Module III (12 hours)

Heat transfer from extended surfaces: Governing equation and boundary conditions-straight rectangular fin-pin fin of uniform cross sectional area-circumferential fin-fin effectiveness-fin efficiency-solving problems using data book.

Heat exchangers: General classification of heat exchangers according to type of energy transfer, according to flow arrangement and according to area to volume ratio-Log Mean Temperature Difference (LMTD) for parallel flow, counter flow and cross flow arrangements-calculation of heat exchanger size and flow rates from known temperatures. Effectiveness_NTU method of evaluation-solving problems using data book.

Module IV (12 hours)

Radiation: Nature of thermal radiation-definitions and concepts-monochromatic and total emissive power-absorptivity, reflectivity and transmissivity-definition of black, grey and real surfaces-concept of a black body-Plank's law, Kirchoff's law, Wein's displacement law and Stefan-Boltzmann law-geometric factor (shape factor or configuration factor) of simple geometries. Heat exchange by radiation between black surfaces of equal, parallel and opposite black squares and discs-black rectangles perpendicular to each other having a common edge-heat exchange between infinite parallel planes of different emissivity-radiation shield (no derivation)-simple derivations and simple problems using data book.

Module V (12 hours)

Mass Transfer: Introduction to mass transfer-Fick's law of diffusion-steady state mass diffusion of gasses and liquids through solids-convective mass transfer (elementary concepts and definitions)-analogy between heat and mass transfer-elementary problems.

Condensation and boiling: Laminar film condensation on a vertical plate and horizontal tubes. Pool boiling-different regimes of pool boiling-flow patterns in flow boiling in a vertical tube.

Two dimensional steady state heat conduction-governing equation and boundary conditions-application of finite difference method in solving two dimensional steady state heat conduction through a rectangular slab (method of discretisation of nodal equations only)

Data Book:

1. C. P. Kothandaraman, S. Subramanyan, *Heat and Mass Transfer Data Book*, 5th ed., New Age International Publishers.
2. A. V. Domkundwar, Dr. V. M. Domkundwar, *Heat and Mass Transfer Data Book*, 3rd ed., Danapat Rai & Co.

References:

Text Books

1. S. P. Sukhatme, *A Text Book on Heat Transfer*, 4th ed.,Universities Press, Hydrabad, 2005
2. S. K. Som, *Introduction to Heat Transfer*, PHI Learning pvt.ltd,New Delhi, 2008
3. P. K. Nag, *Heat Transfer*, 1st ed., Tata McGraw-Hill

Reference Books

1. Frank P. Incropera, David P. Dewitt, *Fundementals of Heat and Mass Transfer*, 5th ed., John Wiley & Sons
2. J. P. Holman, *Heat Transfer*, 9th ed., Tata McGraw Hill Education pvt.ltd., New Delhi, 2010
3. M. Necati Ozisick, *Heat Transfer A Basic Approach*, McGraw Hill Book Company
4. Frank Kreith, Mark S. Bohn, *Principles of Heat Transfer*, 5th ed , PWS Publishing Company
5. S. P. Venkateshan, *A First Course in Heat Transfer*, Ane Books, Chennai

AU010 603: Automotive Transmission

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart basic knowledge to students with respect to transmission system of automobiles and impart knowledge that will enable the students to understand the latest developments in the field.*

Module I (14 hours)

Clutches: Necessity of clutch in a automobile, different types of clutches, friction clutches, cone clutch, Single plate - multi plate, helical spring` & diaphragm spring clutches, centrifugal clutches, electromagnetic clutches, hydraulic clutches, torque capacity of clutches, clutch facing materials, clutch adjustments, over running clutches, sprag and roller clutches, necessity and field of application.
Gear box: Need for a gear box, types of gear transmission, number of gear ratios, 3 speed and 4 speed transmission, determination of gear ratios for vehicles, performance curves in different gears, Types of gearboxes- progressive & Selective types, sliding mesh, constant mesh, synchromesh gear box, Transfer box, selector mechanism, gear types & materials, gearbox oil seals- static & dynamic seals.

Module II (12 hours)

Epicyclic transmission: Principle of planetary gear transmission, Fundamental laws, Typical 2 speed and three speed planetary gear box, Ford-T-model gear box - Wilson planetary transmission, Overdrive unit - Principle of Overdrive, Advantage of Overdrive, Electric control system for overdrive.

Module III (12 hours)

Hydrodynamic drive: Advantages and limitations, fluid flywheel- constructional details, working, merits and demerits, torque transmission and slip characteristics, constructional details of typical torque converters - single and dual stator, matching of torque converters, torque converter lockup-centrifugal, hydraulic & viscous, comparison of torque converter

Module IV (12hours)

Hydrostatic drive: Basic hydrostatic principle, pump and motor combinations for hydrostatic drives , principles of hydrostatic drive systems: construction and working of typical drives, comparison of hydrostatic with hydrodynamic drives, Continuously variable transmission (CVT) –mechanical and hydrostatic, Relative merits and demerits.

Module V (10 hours)

Automatic transmission: General description of working of typical automatic transmissions and their control system, components and parts of Automatic transmission, comparison with conventional transmission. Three speed and reverse Transaxle automatic Transmission, ECTi Automatic transmission with intelligent electronic control system.

Text Books

1. Jack Erjavec – Automotive Engineering Manual Transmissions & Transaxles
2. Newton K / Steeds W / Garrett T.K – Motor Vehicle, Butterworth Heinemann Ltd
3. William H Crouse / Donald L Anglin, Automotive Mechanics , Tata McGraw-Hill Publishers
4. Kirpal Singh – Automobile Engineering Volume 1 & 2 standard publications, New Delhi.
5. Anil Chhikara - Automobile Engineering Vol 2 Power Transmission- Satya Prakashan

Reference Books

1. W. Thomson: Fundamentals of automotive transmission, pitman and paperbacks Publications
2. Narang: Automobile Engineering, Khanna Publications, New Delhi.
3. Judge.A.W, “Modern Transmission systems ", Chapman and Hall Ltd., 1990.
4. SAE Transactions 900550 & 930910.
5. “Hydrostatic transmissions for vehicle applications ", I Mech E Conference, 1981-88.
6. Crouse. W.H., Anglin. D.L., “Automotive Transmission and Power Trains construction ", McGraw-Hill, 1976.

AU010 604: Metrology and Machine Tools

(Common with ME010 604)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *Understand and appreciate the importance of basic principles of traditional material removal processes.*
- *Understand the application of those principles in practice.*
- *To understand the principles of metrology and measurements, methods of measurement and its application in manufacturing industries.*

Module I (12 hours)

Conventional Machining Processes Turning machines:- Types - method of holding work and tool, accessories, attachments-operations and types of tools for each operation - tool room lathe - duplicating lathe - Capstan and Turret lathe – knurling - Drilling:- types of drilling machines - types of drills - nomenclature of drill point - drill wear - types of chip breakers - cutting forces in drilling - Boring:- types of boring machines, tool geometry - counterboring, spot facing, countersinking, trepanning – Reaming:- types of reamers - tool nomenclature - cutting forces - tool materials and surface roughness obtainable in each operations.
Shaping, planing and slotting machines**:-** Types and specifications - quick return motion - hydraulic feed and its advantages - automatic feed-speed, feed and depth of cut -work holding devices - types of operation and examples of work done - shaping of V-blocks, planing of guide gibs, slotting of keyways – Broaching:- - basic process - different cutting elements – force required for broaching and strength of broach – tool materials and surface roughness obtainable in each operations.

Module II (12 hours)

Milling operations:- different types milling machines **-** Different methods of milling - nomenclature of milling cutters – cutting forces in milling – different types of milling cutters – attachments for milling:-vertical milling and universal milling attachment, high speed milling attachment, rack milling and slot attachments, parking bracket, rotary table, universal dividing head, vices, arbors, adaptors and collet chucks – tool materials and surface roughness obtainable in milling – machining centers: applications and advantages - Grinding**:** - types of machines - Grinding mechanisms:- grinding debris, grinding force power, specific energy - Grinding wheels:- different types of abrasives, grain size, different types of bond, grade, structure – marking system of grinding wheels - Grinding fluids – Truing and dressing of grinding wheels - Grinding temperature, thermal damage and surface roughness obtainable.
Horning**:** Types of machines, methods of honing – types honing stones – honing conditions - cutting fluids - surface roughness obtainable - Lapping**: -** types of hand lapping - types of lapping machines - surface roughness obtainable – Burnishing**:-** processes and surface roughness obtainable.

Module III (12 hours)

Gear cutting process**: -** Gear milling: - gear milling machines and different gear milling operations - Gear hobbing: - principle of the hobbing process and hobbing machines, basic types of hobbing machines, different hobbing techniques, nomenclature of hob, hob wear, spur gear hobbing, helical gear hobbing - gear shaping**: -** principle of gear shaping process - gear finishing - gear errors - Thread production process: - different thread production processes: screw cutting on lathe, thread milling, thread whirling, die threading, tapping, thread rolling, and thread grinding.

Module IV (12 hours)
Engineering Metrology

General measurements concepts:- Principles for achieving accuracy; methods for estimating accuracy and precision, precision Vs accuracy, systematic and constant errors; progressive, random, erratic, drunken errors - Fits and tolerances:- types of fits: hole and shaft basis system – limit gauges:- gauge tolerance, presentation of gauge tolerances – Taylor'**s** theory of gauging – limit gauges for screw threads - Design and operation of linear measurements:- Principle of alignment (Abbe's**)**, accuracy and precision etc. – Principle of kinematics: complete constraints, one degree of freedom – Gauge blocks:- gauge materials, accuracy and standards, effect of temperature, surface roughness and manufacturing of gauge blocks – Comparators:- mechanical, mechanical-optical, pneumatic and horizontal length comparator – Angle measurements:- three disc, sine bar and dial gauge – measurement of taper plug ring gauges and taper bores – Precision levels, clinometer – Optical instruments for angle measurements:- optical principles of projector, microscope, telescope, collimator, auto collimator - optical flat and optical parallel applications – auto collimator, angle dekkor, combination of angle gauges, optical flat.

Module V (12 hours)

Tool makers microscope – profile projector – optical microscope, SEM and TEM - straight edge – surface plate – measurement of squareness:- squareness testing with dial gauge, tilting bar, optical square, checking an internal right angle - Measurement of surface roughness: meaning of surface texture and causes – stylus probe instrument, RMS, CLA, peak to valley, R_a, R_t, R_z etc. – stylus, skid, effect of sampling length, magnification, cut-off, evaluation length etc. – comparison of surface roughness of different machining process – concept of apparent to real area of contact of mating surfaces, applications in clutch plate surface, brake liner, inner race of a bearing, cylinder liner, machine tool guide way, significance of surface roughness in crack initiation – assessment of roundness errors:- least square reference circle, minimum circumscribed circle, minimum zone reference circle and maximum inscribed circle – roundness parameters:- eccentricity, concentricity and runout – three wire system of thread pitch diameter measurement - gear tooth measurement by vernier caliper, pin method of measuring gear teeth – Alignment tests for machine tools:- test for level installation of a lathe bed – spindle tests of concentricity and alignment with guide ways – tests for straightness and flatness of a lathe bed guide ways – test for squreness of a drilling machine spindle with table – CMM, laser interferomerty and applications.

Text Books

1. S. Haykin and B. V. Veen, *Signals and Systems*, John Wiley & Sons, N. Y., 2002
2. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, *Signals & Systems*, 2nd ed., Prentice Hall of India, New Delhi, 1997

Reference Books

1. C. L. Philips, J. M. Parr, E. A Riskin, *Signals, Systems and Transforms*, 3rd ed., Pearson Education, Delhi, 2002
2. R. E. Zeimer, W. H. Tranter, and D. R. Fannin, *Signals and Systems: Continuous and Discrete*, 4th ed., Pearson Education, Delhi, 1998
3. M. J. Roberts, *Signals and Systems: Analysis using Transform methods and MATLAB*, Tata McGraw Hill, New Delhi, 2003

AU010 605 Mechatronics and Control systems

(Common with ME010 605)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart basic concepts of mechatronics and control systems.*

Module 1 [12 Hours]

Introduction:-Scope of Mechatronics-Systems-Microprocessor based controllers-mechatronic approach-sensors-transducers-force-velocity-displacement-temperature-inputting data by switches-signal conditioning-operational amplifiers-filtering-multiplexers-data acquisition-modulation. Data presentation systems:- Displays-measurement systems-calibration-pneumatic and hydraulic systems-control valves-actuators-mechanical and electrical activation systems-relays and solenoid switches-proximity pickups.

Module 2 [12 Hours]

Input/output Systems:-Ports, interface requirements, adaptors-programmable logic controllers-data handling digital communications-system, networks, protocols, interfaces, fault finding- design and mechatronic design solutions. Electromechanical systems:-CD, DVD Rom, OCR, Printers.

Module 3 [12 Hours]

Introduction to Control Systems Engineering:-Concept of automatic control-open loop and closed loop systems-servomechanisms-Block diagrams-transfer functions-Representation of control components and systems-Translational and rotational mechanical components –series and parallel combinations-comparators ,integrating devices, hydraulic servomotors, temperature control systems, speed control systems.

Module 4 [12 Hours]

System Response:-First and second order system-Response to step, pulse, ramp and sinusoidal input-systems with distance, velocity lag. Control System Analysis:-Transient Response of simple control systems –Stability of control systems –Routh Stability criteria –Error Analysis.

Module 5 [12 Hours]

Frequency Response Analysis :- Polar ,Rectangular and Logarithmic plots – Experimental determination of frequency response -Bode and Nyquist stability criteria – Gain and phase margin. Root locus of simple transfer function.

Text Books

1. Mechatronics-W.Bolton-Pearson
2. Control Systems- A. Nagoor Kani

References

1. Mechatronics-A.Smaili&F.Mrad-Oxford
2. Control Systems Engg –T .J. Nagrath & M .Gopal.
3. Automatic Control Theory-Ravan.
4. Modern Control Engg.-K. Ogatta
5. Control Systems Engg -Benjamin C Kuo

AU010 606LO1: Vehicle Transport Management

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of vehicle transport management.*
- *To develop an understanding about transport organisation and management, route planning and scheduling, fleet management, fare structure and fare collection system, vehicle design and motor vehicle act.*

Module I (12 hours)

Infrastructure: Types of roads, traffic condition, relief of congestion – pedestrian, bus stops, shelters, bus stations, garages – layout of premises, equipments, use of machinery.
Organization and management: Forms of ownership, principle of transport management – Internal organization, centralized condition, decentralized condition (Engineering, traffic and administration), administration, recruitment and training, welfare, health and safety.
Management Training and Operations- Basic principles of supervising, Organising Time and people, Job instruction training - Training devices and techniques - Driver and mechanic hiring.

Module II (12 hours)

Route planning and Scheduling: Sources of traffic, town planning, turning points, stopping places, survey of rout, factors affecting frequency, direction of traffic flow, estimated traffic possibility. time table layout, use of flat graph method, preparation of vehicle and crew schedules, duty roaster, use of vehicle running numbers, determination of vehicle efficiency, checking efficiency of crew, duty arrangements, duty of drivers and conductors.
Vehicle maintenance, supply management and budget: Scheduled and unscheduled maintenance - Planning and scope - Evaluation of PMI programme – Work scheduling - Overtime - Breakdown analysis - Control of repair backlogs - Cost of options. Cost of inventory - Balancing inventory cost against downtime - Parts control - Bin tag systems – Time management - Time record keeping - Budget activity - Capital expenditures - Classification of vehicle expenses

Module III (12hours)

Fleet Management, Data Processing And Fare Structure : Fleet management and data processing - Data processing systems - Software Model - Computer controlling of fleet activity - Energy management, Basis of fares, effect of competition and control, calculating average charge, zone systems, straight and tapered scales fare structure - Methods of fare collection - Preparation of fare table.
Public relations work: Dissemination of information, maintaining good will, handling complaints, traffic advisory committee, local contacts, co-operation with the press news and articles, forms of publicity, importance of quality, inter departmental liaison, advertisement, general appearance of premises, specialized publicity.

Module IV (12 hours)

Fare collection system: Principles of fare collection, way bill, bell punch system, will brew system, T. I. M. and straight machines, box system, personal and common stock, flat fare basis.

Fare structure: Basis of fares, effect of competition and control, calculating average charge, zone systems, straight and tapered scales, co-ordination of tables, anomalies, double booking, private hire charges.

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

Module V (12 hours)

Vehicle design: Buses & coaches, types & capacities, basic features, entrances & exits, comfort & capacity, steps & staircases, miscellaneous arrangements & fitments, articulated buses, standardization. Traffic navigation and global positioning system.

The future: a projection from the past, future demand, environmental and social issues, the energy situation, new technology, hybrid, battery/trolley bus, other types of hybrid, lead acid battery bus, advanced battery bus

Motor vehicle act: Importance of motor vehicle act: VIII, IX, X & XI schedules, types of driving licenses, procedure for obtaining driving license, registration of vehicle, types of permits, procedure for obtaining permits, third party insurance.

Text Books

1. Bus operation - L.D.Kitchen, Iliffe & Sons , London
2. Bus & coach operation - Rex W. Faulks, Butterworth Version Of 1987, London

Reference Books

1. Compendium of transport terms - Cirt,Pune
2. M.V. Act 1988 - Central Law Agency, Allahabad
3. The elements of transportation - R.J. Eaton
4. Goods vehicle operation - C.S. Dubbar
5. Road transport law - L.D. Kitchen
6. Automobile engineering-G B S Narang, Khanna Publications

AU010 606L02 Computer Aided Vehicle Design

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- To understand how computer can be applied in vehicle design.
- To familiarize with Concepts of modeling in 2D and 3D, Concepts of computer graphics, Theory of analysis and its implementation in CAD.

Note: Use of Software Packages for Analysis and Design of Automobile Systems should use for Design Problem

Module I (12 hours)

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

Module II (12 hours)

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 Dimension and Proportions for Steering Linkages ensuring minimum error in Steering

Module III (12 hours)

Drive Line and Read Axle: Computer Aided Design of Propeller Shaft. Design of Final Drive Gearing. Design details of Full-floating., Semi-floating and Three Quarter Floating, Rear Axle Shafts and Rear Axle Housings.

Module IV (12 hours)

Clutch: Torque capacity of Clutch. Computer Aided Design of Clutch Components. Design details of Roller and Sprag Type of Clutches.

Module V (12 hours)

Gear Box: Computer Aided Design of Three Speed and Four Speed Gear Boxes.

Text Books

1. Dean Averns, “Automobile Chassis Design ″, Iliffe Books Ltd. – 1992
2. Heldt.P.M., " Automotive Chassis ", Chilton Co., New York- 1992
3. Steeds.W., " Mechanics of Road Vehicles ", Iliffe Books Ltd. – 1992

Reference Books

1. Giles.J.G., Steering, " Suspension And Tyres ", Iliffe Books Ltd
2. Newton, Steeds & Garret, " Motor Vehicle ", Iliffe Books Ltd
3. Heldt.P.M., " Torque Converter ", Chilton Book Co., New York

AU010 606L03 Computer Simulation of I C Engines

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *To make the students understand the basic principles of simulation of the combustion processes in engines used for automobiles and the heat transfer mechanism and friction losses of the different systems.*

Module I (12 hours)

Combustion Calculations: Heat of reaction at constant volume and constant pressure, Calculation of properties of the working medium in an engine, Constant volume and constant pressure adiabatic combustion, Calculation of Adiabatic flame temperature.

Module II (12 hours)

Simulation of SI Engine Combustion: Engine kinematics, Ideal Otto cycle, SI engine simulation with adiabatic combustion with air as the working substance under full and part throttle conditions. Actual SI engine heat release rate curves. SI engine combustion models including Wiebe's function

Module III (12 hours)

Simulation of CI Engine Combustion: CI engine simulation with adiabatic combustion with air as the working substance under naturally aspirated, supercharged and turbocharged conditions. Actual heat release rates of diesel engines, Hardenberg and Hase and other ignition delay models for diesel engines, Zero dimensional combustion models for CI engines – Watsons and White House and Way models.

Module IV (12 hours)

Gas Exchange Processes: Flow through valves their characteristics, compressible and incompressible flow through valves, volumetric efficiency and Mach index, Effect of valve timing on volumetric efficiency, Swirl and squish, SI engine simulation with gas exchange, influence of valve timing and area. CI engine simulation with gas exchange.

Module V (12 hours)

Heat Transfer and Friction in Engines: Engine friction variation, models for engine friction, Heat transfer mechanisms in engines, Models for heat transfer in engines. Two stroke engine scavenging parameters like delivery ratio, scavenging efficiency, trapping efficiency. Perfect displacement and perfect mixing models for scavenging.

Text Books

1. Computer simulation of compression ignition engine processes by V.Ganesan, Universities Press
2. Computer simulation of Spark Ignition Engine Processes by V Ganesan,Universities Press
3. Richard Stone, Introduction to Internal Combustion Engines

Reference Books

1. Internal Combustion Engines – Applied Thermo Sciences, Colin R Ferguson, John Wiley and Sons.
2. Internal Combustion Engine Fundamentals, John B Heywood, Mc Graw Hill

AU010 606L04 Tribology

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Module I (12 hours)

Introduction to Tribilogy: Properties of oils and equation of flow: Viscosity, Newton's of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, classification of lubricants.
Hydrodynamics Lubrication: Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, idealized full journal bearings.

Module II (14 hours)

Mechanism of pressure development in an oil film, Reynold's investigations, Reynold's equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems.
Slider / Pad bearing with a fixed and pivoted shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, influence of end leakage, numerical examples.

Module III (10 hours)

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

Module IV (10 hours)

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

Module V (14 hours)

Bearing Materials: Commonly used bearings materials, properties of typical bearing materials. Wear: Classification of wear, wear of polymers, wear of ceramic materials, wear measurements, effect of speed, temperature and pressure.
Behaviour of tribological components: Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. Tribological measures: Material selection, improved design, surface engineering

Text Books

1. Basu S K., Sengupta A N., Ahuja B. B.,Fundamentals of Tribiology, PHI 2006
2. Mujumdar B. C., Introduction to Tribiology bearings, Wheelers and company pvt. Ltd 2001.

Reference Books

1. Fuller, D., Theory and Practice of Lubrication for Engineers, New York company 1998
2. Moore, Principles and applications of Tribiology, Pergamaon press 1998
3. Srivastava S., Tribiology in industries, S Chand and Company limited, Delhi 2002
4. Redzimovskay E I., Lubrication of bearings – theoretical principles and design, Oxford press company 2000

AU010 606L05 Alternate Fuels and Energy systems

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of energy and its sources.*
- *To develop a clear understanding about the alternative fuels for the I.C engines.*

Module I (15 hours)

Types of energy sources (conventional and non-conventional energy), their availability. Scenario of conventional automobile fuels, oil reserves of the world, need of alternative energy sources. I.C engine fuel ratings- octane number, cetane number, diesel index, fuel properties, additives, fuel quality aspects related to emissions. Implementation barriers for alternative fuels, roadmap for alternative fuels.

Module II (15hours)

Alcohols for SI engines- manufacture of methanol, manufacture of ethanol, comparison of properties of alcohols and gasoline as SI engine fuels, engine performance with pure alcohols, alcohol gasoline fuel blends-gasohol- E85.
Alternate fuels for Diesel engines: Alcohols as diesel fuels, vegetable oils as diesel fuels, straight vegetable oils and bio-diesels, performance properties of
engines with bio-diesel, Indian specification for bio-diesel,

Module III (15 hours)

Hydrogen energy: Properties of hydrogen, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo – chemical production and biochemical production, storage and methods, applications to engines, modifications necessary, hazards and safety systems for hydrogen , performance characteristics in engines. Emissions from hydrogen fuel engines. Fuel cell working, advantages and limitations.

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Module IV (15 hours)

Gaseous fuels: Availability of CNG, LNG, properties, modification required to use CNG in engines, performance and emission characteristics of CNG.
LPG as an IC engine fuel, modification required for the engine, performance and emission characteristics of LPG. Description of hybrid LPG – gasoline engine.
Biogas production, application of biogas as a single fuel and dual fuel dual fuel

Module V (15 hours)

Solar power: Collection and storage of solar energy, collection devices, flat plate collectors, concentrating type collectors, storage methods, principle and working of photovoltaic conversion, application to automobiles.

Electric vehicles: Design considerations, limitations, opportunities for improvement, batteries, problems, future possibilities, capacities, types, applicability of electric cars, cost of electric car.

Text Books

1. Mathur & Sharma – IC engines, Dhanpatrai publications
2. Dr.N.K.Giri- Automobile technology, khanna publications

Reference Books

1. T. K. Garrett: Automotive fuels system, SAE INC, Warrendale, 1991
2. Keeith Owen & Trevor Colley - Automotive Fuels reference book, SAE
3. Richard L. Bechtold- Alternate fuels guide book, SAE
4. Energy research group- Alternate liquid fuels Willey Eastern Ltd
5. T.N Vezgirigiu- Alternative energy sources
6. Nagpal - "Power Plant Engineering" - Khanna Publishers –
7. G.D Rai Solar energy

AU010606L06: Quantitative Techniques

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To understand and apply Quantitative techniques to industrial operations.*
- *To equip the students to grasp the various optimization techniques*

Module I (8 hours)

Linear programming, Definition, scope of Operations Research, O.R. approach and limitations of OR Models, Characteristics and phases of OR, Mathematical formulation of L.P. Problems. Graphical solution methods.

Module II (15 hours)

The simplex method - slack, surplus and artificial variables. Concept of duality, two phase simplex method, dual simplex method, degeneracy, and procedure for resolving degenerate cases.

Module III (15 hours)

Formulation of transportation model, Basic feasible solution using North-west corner rule, least cost or Matrix Minima method, Vogel's approximation method, Optimality Methods-modified distribution method – stepping stone method, unbalanced transportation problem, degeneracy in transportation problems, maximisation problems, application of Transportation problems.
Assignment Problem: Formulation, Hungarian assignment method, maximisation problem - unbalanced problem, multiple solution problems, restriction on assignment

Module IV (10 hours)

Game Theory: Von Neumann's theorem– Two Person Zero-Sum Games, Pure Strategies, Games with Saddle Point, Mixed strategies, Rules of Dominance, Solution Methods of Games without Saddle point – method of matrices – method of linear programming – iterative method of approximate solution-Graphical solution (2xn, mx2 game).

Module V (8 hours)

Basic structure of queuing models – exponential and Poisson distributions – queuing models based on Poisson inputs and exponential service times – basic model with constant arrival rate and service rate – Poisson–exponential single server model, infinite population – Poisson-exponential single server model, finite population – Poisson-exponential multiple server model, infinite population.

TEXT BOOKS

1. N.D.Vohra, “Quantitative Techniques in Management “ Tata Mcgraw Hill
2. Taha H.A, “Operation Research”, Pearson Education sixth edition.

REFERENCES

1. Frederick.S.Hiller and Gerald.J.Lieberman, “Operations research concepts and cases”, TMH edition.
2. J.K.Sharma, “Operations research theory and applications”, Macmillan India .
3. Hira and Gupta “ Problems in Operations Research”, S.Chand and Co.
4. Panneerselvam, “Operations Research” Prentice Hall of India.
5. G Srinivasan, “Operations research principles and applications”, PHI .
6. Wagner, “Operations Research”, Prentice Hall of India.

AU010 607: HEAT ENGINES LABORATORY

(Common with ME010 607 and AN010 607)

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To provide experience on testing of IC engines performance.*

Study of systems and components of IC Engines and automobiles - study of dynamometers used in engine testing - study of IC Engine repairs and maintenance.

Study of boilers, boiler mountings and accessories - study of steam engine parts and systems.

Testing of IC engines • Performance analysis of IC engine using computerized test rig-
Load test on petrol and diesel engines- determination of indicated and brake thermal efficiencies - mechanical efficiency - relative efficiency - volumetric efficiency - air-fuel ratio and compression ratio - valve timing diagram - retardation test - Morse test - heat balance - effect of varying the rate of cooling water and varying the speed on the performance characteristics of engines.

Testing of steam boiler - boiler trial - steam calorimeters and steam nozzles - performance test on steam engines - performance test on steam turbines.

Testing of fuels and lubricants - determination of flash and fire points of petroleum products - determination of kinematics and absolute viscosity of lubricating oils - determination of calorific values

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
30% - Viva voce

AU 010 608 Machine Tool Laboratory

(Common with ME010 608)

Teaching scheme **Credits:** 2

3 hours practical per week

List of Experiments

1. Study of precision tools used in machine tool laboratory: – Vernier caliper, micrometers, surface plates, surface gauges, gauge block, straight edges, dial gauge, plug and ring gauges, slip gauges, sine bar, care of tools and gauges. – **2 practices**.
2. Study of lathe tools and accessories: - Selection of tool for different operations - tool materials: high carbon steel, HSS, cemented carbides, coated WC, indexable inserts, alumina, cBN, diamond etc. - tool nomenclature and attributes of each tool angles on cutting processes – effect of nose radius, side cutting edge angle, end cutting edge angle and feed on surface roughness – tool grinding and safe working practices. - 1 **practice.**
3. Selection of speeds, feeds and depth of cut – selection of cutting fluids – different methods of holding work. **- 1 practice.**
4. Experiment on arc and gas welding: - butt welding and lap welding of M.S. sheets. **- 1 practice.**
5. (a) Measurement of cutting forces in turning process using dynamometers.
   (b) Experiment on lathe:- Facing, plain turning, step turning and parting - groove cutting, knurling and chamfering - form turning and taper turning - eccentric turning.
   (c) Measurement of flank wear in turning process using tool makers microscope.
   - 3 practices.
6. Experiment on thread cutting: - single and multistart external and internal threads, square and V-threads. **- 1 practice.**
7. Disassembly and assembly of small assemblies such as tail stock, bench vice, screw jack etc. **- 1 practice.**
8. Experiment on drilling machine: - drilling, boring, reaming and counter sinking – taping – study of reamers and taping. **- 1 practice**.
9. Study and demonstration of N.C. machines:- CNC machines components - Point to point, straight cut and contouring positioning - incremental and absolute systems – open loop and closed loop systems – DDA integrator and interpolators - part programming fundamentals - manual programming – tape format – sequence number, preparatory functions, dimension words, speed word, feed world, tool world, miscellaneous functions – Computer aided part programming:- APT language structure: geometry commands, motion commands, postprocessor commands, compilation control commands – programming, simulation and demonstration exercises involving plane taper and form turning etc.
   - 3 practices.

Besides to the skill development in performing the work, prepare the control charts and oral examination should also be carried out. Observation and record books are to be maintained.

The student's assessment, continuous evaluation, awarding of sessional marks, record bonafides, oral examination etc and University examination shall be carried out by the faculty members (lecturer and above).

TEXT BOOKS:

1. Acharkan. N., Machine Tool Design Vol. 1 to 4, MIR Publication.

REFERENCE BOOKS:

1. Chapman, Workshop Technology, Vol II, ELBS.
2. HMT, Production Technology, Tata McGraw Hill.
3. Yoram Koren, Numerical Control of Machine Tools, McGraw-Hill.

AU 010 701 Design of Machine Elements
(Common with ME010 701)

Teaching scheme **Credits:** 4

2 hours lecture, 1 hour tutorial and 1 hour drawing per week

Objectives

To provide basic knowledge on the design considerations and methodology of various machine elements.

Module I (15 Hrs)

System design cycle - Different phases in design process - design factors and considerations - tolerances and fits - Hole basis & Shaft basis system - standardization - selection of materials - stress concentration - Methods to reduce stress concentration - theoretical stress concentration factor - theories of failure - Guest's theory - Rankine's theory - St. Venant's theory - Haigh's theory - Von Mises & Hencky theory - shock and impact loads - fatigue loading - endurance limit stress- Factors affecting endurance limit - Factor of safety - creep and thermal stresses.

Module II (15 Hrs)

Design of riveted joints- Failure of riveted joints and efficiency of joint -boiler and tank joints- structural joints, Cotter and Knuckle joints

Threaded joints - thread standards- thread nomenclature - stresses in screw threads- bolted joints preloading of bolts- eccentric loading- fatigue loading of bolts - Power screws.

Module III (15 Hrs)

Design of welded joints- Representation of welds - stresses in fillet and butt welds- design for static loads - bending and torsion in welded joints- eccentrically loaded welds - design of welds for variable loads.

Springs- stresses and deflection of helical springs with axial loading - curvature effect - resilience - design of spring for static and fatigue loading- surging- critical frequency- stress analysis and design of leaf springs..

Module IV (15 Hrs)

Shafts and axles design- stresses- causes of failure in shafts - design based on strength, rigidity and critical speed- design for static and fatigue loads- repeated loading- reversed bending-

Design of couplings - Rigid and flexible couplings - design of keys and pins.

Note: Any one of the following data book is only permitted for reference in the University examination

1. Machine Design Data hand book by K. Lingaiah, Suma Publishers, Bangalore/ Tata Mc Graw Hill
2. PSG Design Data, DPV Printers, Coimbatore.

Text Books

1. C.S, Sarma, Kamlesh Purohit, Design of Machine Elements, Prentice Hall of India Ltd , New Delhi
2. M. F. Spotts, T. E. Shoup, Design of Machine Elements, Pearson Education.
3. V.B. Bhandari, Design of Machine Elements, McGraw Hill Book Company

Reference Books

1. J. E. Shigley, Mechanical Engineering Design, McGraw Hill Book Company

AU010 702 Advanced Automotive Technology

Teaching scheme **Credits:** 4
2hours lecture and 2 hour tutorial per week

Objectives

- *To develop a clear understanding about the modern developments in I.C engine technologies.*

Module I (9 hours)

I.C Engine cycles and analysis: Otto cycle, Diesel cycle, dual cycle. Comparison of air standard cycle & fuel air cycle with actual cycle, effects of variation of specific heat, dissociation effect, and numerical problems related to different cycles. Comparison of engine cycles with respect to compression ratio, heat input and pressure.

Module II (9 hours)

Gas turbine plants – Open and closed cycles – thermodynamic cycles – regeneration – re heating – inter cooling – efficiency and performance of gas turbines – Gas turbine as automotive engine – Limitations of gas turbine in automotive sector. Comparison of gas turbine vs. I.C engine. Condition for perfect reheating and inter cooling. simple problems
Rotary compressors – centrifugal and axial compressors – Combustion – combustion chambers of gas turbines – cylindrical, annular combustion chamber.

Module III (8 hours)

Supercharging: Introduction, Objectives of supercharging, thermodynamic cycle, effects of supercharging in S.I and C.I engines, performance of the supercharged engine, supercharging limits, methods of supercharging, superchargers, turbo charging, methods of turbo charging and its advantages, limitations of turbo charging.

Module IV (9 hours)

Dual fuel engine concepts and significance , factors affecting combustion in dual fuel engines, performance of dual fuel engines.
Multi fuel engines, characteristics of multi fuel engines, performance of multi fuel engines.
Modern developments in IC engines: Stratified charged engine- working, methods, Stirling engine, Wankel engine, variable compression ratio (VCR) engine, lean burn engines, ceramic engines (Concept, working and advantages). Concept and working

of flexi fuel vehicles (FFV). Introduction to Hybrid cars.

Module V (8 hours)

Vehicle Operation and Control: Electronic transmission control, chassis control system, adaptive noise control, Electronic (Adaptive) cruise control
Antilock braking system, Automatic Traction control, Automatic stability control, EBD, Central locking, Air bags
Electronically controlled suspension, Adaptive suspension, Active suspension systems-requirement and characteristics.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. M. L. Mathur, R. P. Sharma - Internal Combustion Engines, Dhanpat Rai Publications
2. R.K. Rajput, Internal Combustion Engines, Laxmi Publications
3. A.W. Judge, Modern petrol engine, Chapman and Hall, London
4. Heinz Heisler, Advanced Vehicle Technology, Society of Automotive Engineers Inc

Reference Books

1. James D. Halderman, Chase D. Mitchell Automotive steering, suspension, and alignment Prentice Hall
2. Don Knowles, Automotive Suspension and Steering Systems
3. H.N. Gupta, Fundamentals of Internal Combustion Engines, Prentice Hall of India Ltd
4. V. Ganesan, Internal Combustion Engines, Tata McGraw-Hill Education
5. William B Riddens, “Understanding Automotive Electronics”, 5th edition, Butter worth Heinemann Woburn,1998
6. Beranek. L.L. Noise Reduction, McGraw-Hil Book Co., Inc, Newyork, 1993
7. Robert Bosch, Automotive Handbook, Bently Publishers, 2004

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 3 marks=15 marks*
PART B:	*Descriptive/Analytical questions* Candidates have to answer five questions out of seven. There should be at least one question from each module and not more than two questions from any module.	*5 x 5 marks=25 marks*
PART C:	*Descriptive/Analytical questions* Two questions from each module with choice to answer one question.	*5 x 12 marks=60 marks*

Maximum Total Marks: 100

AU010 703: Auto Electrical & Electronics

Teaching scheme **Credits:** 3
2 hours lecture and 1 hour tutorial per week

Objectives

- To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems like Batteries, Starting System, Charging System, Ignition System, Lighting System and Dash – board Instruments and sensors.

Module I (8 hours)

Storage battery: Principle of lead acid battery & constructional details, effect of temperature on electrolyte, Capacity Rating, efficiency of battery, battery charging methods, alkaline battery, Battery tests, battery maintenances. Recent development in batteries.

Module II (9 hours)

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, starting circuit, Starter Switches and Solenoids.
Charging system components: Generators and Alternators, types, construction and Characteristics. Voltage and Current Regulation, Cut–out relays and regulators, Charging circuits for D.C. Generator, A.C. Single Phase and Three – Phase Alternators.

Module III (9hours)

Battery Coil and Magneto–Ignition System, Circuit details and Components of Battery Coil and Magneto–Ignition System, Centrifugal and Vacuum Advance Mechanisms, Spark Plugs, Constructional details and Types.

Electronically–assisted and Full Electronic Ignition System, Non–Contact–type Ignition Triggering devices, Capacitive Discharge Ignition, Distributor–less Ignition System, Digital Ignition System, Control Strategy of Electronic Ignition System.

Module IV (8 hours)

Automotive Wiring, Insulated and Earth Return System, Positive and Negative Earth Systems, Head Lamp and Indicator Lamp Details, Anti–Dazzling and Dipper Details, Theory and Constructional Details of Dash Board Instruments and their Sensors like Speedometer, Odometer, Fuel Level Indicator, Oil Pressure and Coolant Temperature Indicators, Horns and Wiper Mechanisms, Automotive Wiring Circuits.

Module V (8 hours)

Types of sensors: Pressure sensor, throttle position sensor, fuel flow sensor, temperature sensor, oxygen sensor, speed sensor.
Electronic fuel injection system, types of gasoline fuel injection system, D-jetronic, K-jetronic, L-jetronic fuel injection, Electrical and Electronic Fuel Lift Pumps, electronically controlled fuel supply system in petrol & diesel engines.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Kholi .P.L. Automotive Electrical Equipment, Tata McGraw-Hill co ltd
2. Young, A.P. and Griffith, S.L., Automobile Electrical Equipments, ELBS and New Press.

Reference Books

1. Jim Horner, Automotive Electrical Hand Book
2. William B. Ribbens, Norman P. Mansour, Understanding automotive electronics, Newnes, 2003
3. Barry Hollembeak, Automotive Electricity & Electronics
4. Crouse.W.H., Automobile Electrical Equipment, McGraw Hill Book Co Inc, New York, 2005
5. Judge.A.W., Modern Electrical Equipments of Automobiles, Chapman & Hall, London 2004
6. Robert Bosch, Automotive Handbook, Bently Publishers, 2004

AU010 704: Refrigeration and Air Conditioning
(Common with ME010 704)

Teaching scheme **Credits:** 3

2 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of Refrigeration and Air Conditioning*
- *To develop a sound physical understanding of the subject so that the learner will demonstrate the ability to design a refrigeration or air-conditioning equipment that meets the required specifications*

Module 1 (8 hours)

Principles of refrigeration: Thermodynamics of refrigeration – Carnot, reversed carrot cycle, heat pump, and refrigerating machine- coefficient of performance -unit of refrigeration- refrigeration methods - conventional refrigeration systems. Air refrigeration system -Bell Coleman cycle -C.O.P –capacity, work and refrigerant flow requirements in Bell Coleman cycle.

Module 2 (10 hours)

Vapor compression system: simple cycle -comparison with Carnot cycle, theoretical and actual cycles- COP- effect of operating parameters on COP- wet, dry and superheated compression- sub cooling - actual cycle representation on TS and PH diagrams- simple problems. Advanced vapor compression systems – multistage vapor compression systems- flash chamber- multiple compression and evaporation systems- cascading -simple problems.

Module 3 (10 hours)

Vapor absorption systems: simple cycles-actual cycle- ammonia water and lithium bromide water systems – COP -Electrolux system. Refrigerant and their properties: Nomenclature- suitability of refrigerants for various applications -unconventional refrigeration methods- vortex tube, steam jet, magnetic (Cryogenics) refrigeration and thermoelectric refrigeration- applied refrigeration: house hold refrigerator –unit air conditioners and water coolers- ice plant -cold storage

Module 4 (7 hours)

Refrigeration system components (Theory Only): water and air cooled condensers- evaporative condensers- expansion devises -capillary tube -constant pressure expansion valve- thermostatic expansion valve- float valve and solenoid valve. Evaporators: natural convection coils -flooded evaporators -direct expansion coils. Reciprocating compressors: single stage and multistage compressors- work done -optimum pressure ratio -effect of intercooling- volumetric efficiency -

effect of clearance- isothermal and adiabatic efficiency. Rotodynamic compresors: Screw and vane type compressors- principle of operation- hermetic, semi hermetic and open type refrigeration compressors.

Module 5 (10 hours)

Principles of air conditioning: Psychrometry and psychrometric chart - human comfort- effective temperature- comfort chart. Applied psychrometry: sensible heat factor- psychometric process – problems. Winter air conditioning- heating load calculations- humidifiers and humidistat. Summer air conditioning- cooling load calculations- year round air conditioning -unitary and central systems -principles of air distribution -design of air duct systems.

Text Books

1. Stoecker W.F. and Jones J.W, *Refrigeration and Air-Conditioning*, McGraw- Hill
2. Jordan and Prister, *Refrigeration and Air-Conditioning*, Prentice Hall of India.

Reference Books

1. Dossat., *Principles of Refrigeration*, John Wiley and Sons
2. Robert H. Enerick, *Basic Refrigeration and Air-Conditioning*, Prentice Hall.
3. Arora C.P., *Refrigeration and Air-Conditioning*, Tata McGraw- Hill

AU 010 705: Industrial Engineering
(Common with ME010 705)

Teaching scheme **Credits:** 4
2 hours lecture and 1 hour tutorial per week

Objectives

- *To provide an exposure to the fundamental tools and techniques in Industrial Engineering for integration and improvement of inter related work activities and productivity management.*

Module I (9 hours)
Introduction: Evolution of industrial Engineering, Branches and Fields of application of Industrial Engineering, Functions of Industrial Engineer. Types of production- Productivity- Productivity index- factors affecting productivity-techniques for productivity improvement.
Product development and design: Requirements of a good product design- product development process- product analysis. Value Engineering: Fundamental Concepts- reasons for poor values- types of values- Applications and benefits of Value Engineering.
Module II (9 hours)
Facility planning: Plant location-Procedure for site selection- Plant layout-Objectives and principles of plant layout- types of layout- Factors influencing layout- introduction to layouts based on group technology, just-in-time and cellular manufacturing systems.
Material Handling: Functions and Principles of material handling, Selection of material handling equipments-types of material handling equipments.
Module III (9 hours)
Materials Management: Objectives, functions and scope of materials management. **Purchasing** - Objectives and functions-purchasing procedure- buying techniques- Vendor development and rating system- Stores management.
Inventory Control: Objectives of inventory control-inventory costs-Determining inventory level- EOQ model-Models with shortages-Continuous and Periodic Review systems-ABC analysis- Make or buy decision-Vendor Managed Inventory.
Module IV (9 hours)
Methods engineering: Work study-Procedure for motion study- Recording Techniques- Micro motion study- Work measurement techniques- Time study.
Industrial Ergonomics: Introduction to Ergonomics-Objectives of Human Engineering- Aspects of Man- Machine System- Workplace design.
Job Evaluation and Merit Rating: Objectives of Job evaluation, methods of job evaluation, merit rating, Types of merit rating.
Module V (9 hours)
Inspection and Quality Control: Objectives and kinds of inspection-methods of inspection-Objectives of quality control- Statistical quality control-control charts, problems- Acceptance sampling-Total quality management- ISO systems-QFD-Benchmarking.

Text Books

1. Verma A.P., *Industrial Engineering,* S. K. Kataria & Sons.
2. Sharma S. C. & Banga T. R., *Industrial Organization and Engineering Economics,* Khanna Publishers.

Reference Books

1. Tompkins J.A and White J.A. , *Facilities Planning,* John Wiley, N.Y.,1984.
2. Tony Arnold, J.R, *Introduction to materials management,* Prentice hall inc, N.J,1998.
3. Tayyari and Smith J.L., *Occupational Ergonomics; principles and Applications,* Chapman and Hall publication, U.K., 1997

AU010706L01 VEHICLE BODY ENGINEERING

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *At the end of the course, the students will be able to have a sound knowledge for the design of the vehicles body to give maximum comfort for the passengers and exposed to the methods of stream lining the vehicles body to minimize drag.*

Module I (8 hours)

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

Module II (9 hours)

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

Module III (8 hours)

Aerodynamics: Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles
Interior Ergonomics: Introduction, ergonomics system design, Seating dimensions ,seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout.
Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms

Module IV (8 hours)

Load distribution: Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation for static, symmetrical, longitudinal & side loads, stress analysis of bus body structure under bending and torsion.
Vehicle Stability: Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

Module V (9 hours)

Noise and vibration: Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression
Safety: Impact protection basics, Physics of impact between deformable bodies, Design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Sydney F page, "Body Engineering"' Chapman & Hall Ltd, London, 1956
2. "Giles J Pawlowski", Vehicle body engineering Business books limited, 1989
3. John Fenton, "Vehicle body layout and analysis", Mechanical Engg. Publication ltd, London.

Reference Books

1. Giles,G.J., Body construction and design, Illiffe Books Butterworth & Co., 1971.
2. Braithwaite,J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London, 1977.
4. Dieler Anselm., The passenger car body, SAE International, 2000 S. P. Page – Body Engineering.
5. Paul Browne – Auto care manual.
6. Redesign of bus bodies – Part 1 and Part 2 C. I. R. T., Pune.

AU010 706L02 VEHICLE PERFORMANCE AND TESTING

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objective

- *To provide knowledge about various Vehicle Performance Characteristics.*

Module I (9 hours)

Laboratory testing: Basic engine parameters, Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers- hydraulic, eddy current etc, engine analyzers- for petrol and diesel engines, FIP calibrating and testing, exhaust gas analyzers - various types- Orsat apparatus, infrared gas analyzers, smoke meter.

Module II (8 hours)

Noise vibration and Harshness: Review of vibration fundamentals, vibration control, fundamentals of acoustics, human response to sound, automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.

Module III (8 hours)

Vehicle performance: Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, emission and fuel economy, Operation of full load and part conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, CAFÉ standards.

Module IV (8 hours)

Road and track testing: Initial inspection, PDI, Initial free services, engine running in and durability, intensive driving, maximum speed and acceleration, brake testing on the road, hill climbing, handling and ride characteristics, safety, mechanism of corrosion, three chamber corrosion testing, wind tunnel testing, road testing, test tracks.

Module V (8 hours)

Vehicle testing on chassis dynamometers: two wheel & four wheel dynamometers, vehicle testing lanes - side slip testers, wheel alignment testing, wheel balancing, brake testers, head light alignment testing.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. J. G. Giles – Vehicle operation and performance, Wildlife Publications, London, 1969.
2. W. H. Crouse and L. Anglin – Motor vehicle inspection, McGraw Hill Book Co. 1978.
3. Dr. N.K.Giri- Automotive technology – Khanna publishers, 2009

Reference Books

1. SAE Transaction papers – 831814, 820346, 820367, 820371, 820375.

AU010 706L03 AUTOMOTIVE POLLUTION AND CONTROL

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To make the students to realize the impact of automobile emissions on the environment and expose student to factors affecting the formation and control of automobile pollutants*

Module I (9 hours)

Introduction: General Scenario on automotive Pollution, effects on human beings and environment, Historical background, Laws and regulations, Emission Standards, Regulatory test procedure -Bharat Stages & Euro emission. Driving cycles – USA, Japan, Euro and India. Exhaust gas pollutants, particulate pollutants from engines. Influence of Fuel Properties: Effect of petrol, Diesel Fuel, effect of different Fuels and lubricants in emissions

Module II (8 hours)

Pollutant formation in SI Engines, mechanism of HC and CO formation in four stroke and two stroke SI engines, NOx formation in SI engines, effects of design and operating variables on emission formation, Two stroke engine pollution.
Pollutant formation in CI engines, smoke and particulate emissions in CI engines, effects of design and operating variables on CI engine emissions. NOx formation.

Module III (8 hours)

Pollution control techniques in SI & CI Engines: Design of engine, optimum selection of operating variables for control of emissions, EGR, Thermal reactors, secondary air injection, catalytic converters, catalysts, fuel modifications, lean burn strategies in SI Engines, Road draught crankcase ventilation system, positive crankcase ventilation system, fuel evaporation control, particulate traps, Diesel Trap oxidizer, Two stroke engine pollution control

Module IV (8 hours)

Test Procedure & Instrumentation for Emission Measurement: Test procedures- Calculation of volume of Exhaust gases, Volume of constituents for perfect combustion, Measurements of invisible emissions -ORSAT apparatus, NDIR analyzer, Flame ionization detectors, Chemiluminescent analyzer, Gas analyzer,oxygen analyzer
Measurements of visible emissions – Comparison methods & Obscure methods - Smoke meters .

Module V (8 hours)

Noise pollution from automobiles: Noise, Vibration And Harshness, Sources of Noise, Measurement of Noise -Engine Combustion Noise, Inlet And Exhaust Noise, Traffic Noise, Vehicle Body Noise - control of noise, control devices and noise proof materials.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Paul Degobert – Automobiles and Pollution – SAE International ISBN-1-56091-563-3, 1991
2. Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2003.
3. Beranek.L.L. " Noise Reduction", McGraw Hill Book co., Inc, New York, 1993.
4. B.P. Pundir, "Engine Emissions", Narosa Publishing House, 2007

Reference Books

1. SAE Transactions- "Vehicle Emission"- 1982 (3 volumes).
2. Obert.E.F.- "Internal Combustion Engines"- 1988
3. Marco Nute- " Emissions from two stroke engines, SAE Publication – 1998.

AU010 706L04 PROJECT MANAGEMENT

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objective

- *To enable the students understand the concept of project management and illustrate the various systems and procedures involved*

Module I (9 hours)

Concept of project, Categories of projects, Project life cycle, Concept of project management , Tools and techniques for project management, The project manager, Roles and responsibilities of project manager, Project formulation, Formulation of stages, Bottlenecks, Feasibility Report, Finance arrangements, Finalization of project, Implementation of project.

Module II (8 hours)

Administrative agencies for project approval, Ministry of finance, Bureau of public enterprises, Planning commission, Public Investment Board. Organizing human resources and contracting-Delegation of project manager's Authority, Project organization, Accountability in project execution, Contracts, 'R' of Contracting, Tendering and selection of contractors, Team building, role of incubation centres for budding entrepreneurs, DST projects for entrepreneurship.

Module III (8 hours)

Organizing and working of systems, Design of systems, Project work system Design, work breakdown structure, project execution plan, project procedure, manual project control system, planning , scheduling , monitoring and controlling, monitoring contracts and project diary.
Project implementation, stages of project direction, communication in a project, coordination guidelines for effective implementation, Reporting in project management, project evaluation and its objectives, types, and methods

Module IV (8 hours)

Financial estimates and projections: Cost of projects, means of financing, estimates of sales and production, cost of production, working capital requirement and its financing, profitability, projected cash flow statement and balance sheet. Break even analysis.
Basic techniques in capital budgeting-non discounting and discounting methods- payback period- Accounting rate of return-net present value-Benefit cost ratio-internal rate of return. Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects.

Module V (8 hours)

Project administration- progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), Concepts and uses of PERT.

MS Project: (Software Practice) Creation of task, sequencing of task, assignment of resources, finding critical path, ABC activities (discuss), breaking the activities, colouring techniques, resource balancing, allocating overtime, using different calendars (Like 8 or 12 hours shift, Friday/ Sunday holiday, Special public holidays, etc), cost estimates, assignment of blank fields, creation of different views on screen.
Reports: Daily reports for completed activity, lagging activities, overall progress review, Management high – level reports, individual Departmental reports.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. B.B. Goel-Project Management-Deep and Deep Publications, New Delhi,2004
2. Choudhury-S. Project Management –TaTa Mc Graw –Hill- Publishing Company Limited, New Delhi,2005
3. Prasanna Chandra, Project Management, Tata McGraw Hill.

Reference Books

1. Mattin.C.C. Project Management-American Management Association, New York,1976.
2. Denis Lock-Project Management-Coles Publishing company,1980
3. Harvey Maylor, Project Management, Pearson Education.
4. Corter, Mastering MS Project 2000, BPB Publishers.

AU010 706L05 INDUSTRIAL SAFETY

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *The students will be able to create a draft addressing the principles for developing and implementing a occupational health and safety program and evaluation of a work site.*
- *The students will be able to conduct basic safety inspections*

Module I (9 hours)

Introduction:- Introduction to the development of industrial safety and management, History and development of Industrial safety, formation of various council, safety and productivity, safety organizations, Safety committees- need, types, advantages, structure. Safety Education and training- Importance, various training methods . Role of management and role of Govt. in industrial safety, safety analysis.

Module II (8 hours)

ACCIDENT PREVENTION: - Definitions and theories, Accident, Injury, unsafe condition, Dangerous occurrence- Theories and principles of accident causation. Cost of accidents- Accident reporting and investigations. Accident prevention- Motivating factors,Safety suggestion schemes. Safety performance- Definitions connected with measuring safety performance as per Indian and International standards. Personal protective equipment- survey the plant for locations and hazards, part of body to be protected
Economic importance of accidents, Types of safety organizations, Analysis of accident records, accident investigations, Analysis of accident Safety standards for Mechanical equipment.

Module III (8 hours)

SAFETY IN MATERIAL HANDLING:- General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers. Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, travelling and slewing mechanisms. Selection, operation and maintenance of Industrial Trucks – Mobile Cranes – Tower crane.

Module IV (8 hours)

Regulations for Health, Safety and Environment : - The Acts which deal the safety

and industrial hygiene: Features of Factory Act, explosive Act, boiler Act, ESI Act, Workman's compensation Act . Indian explosive act Environmental pollution act - Indian petroleum act and rules. Oil industry safety directorate (OISD)

Module V (8 hours)

Automobile Industry Safety Practices: - Safety programmes in major two wheeler, four wheeler , heavy vehicles manufacturing inustries. case studies. Safety practices in assembly units. Safety practices in painting booth of automobile industries. Safety clubs in companies. Safety officers roles.
Safety programmes in automobile service stations. Computers in maintenance: Features and benefits of Computer aided maintenance. Application of computers to maintenance work.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Handlin, W., Industrial Hand Book, McGraw-Hill, 2000.
2. Anton, T. J., Occupational safety and health management, (2nd ed.). New York, NY: McGraw Hill, Inc, 1989.
3. Ray Asfahl C., "Industrial Safety and Health Management"
4. Willie Hammer, "Occupational Safety Management and Engineering"
5. N.V. Krishnan, "Safety in Industry", Jaico publishers House – 1996

Reference Books

1. Heinrich, H.W., *Industrial Accident Prevention*, McGraw-Hill, 1980
2. Rudenko, N., *Material Handling Equipments*, Mir Publishers, Moscow, 1981.
3. Lees, F.P., *Loss Prevention in Process Industries*, Butterworths, NewDelhi, 1986.
4. Canter, R. L., *Environmental Impact Assessment*, McGraw Hill.
5. Oil Industry Safety Directorate, Govt. of India web site

AU010 706L06 NON – TRADITIONAL MACHINING PROCESSES

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *The students will be able to study non traditional machining processes in various industries.*

Module I (8 hours)

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

Module II (9 hours)

Abrasive Jet Machining (AJM):Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean No. abrasive particles per unit volume of the carrier gas, work material, stand off distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining : Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery
Electrochemical machining (ECM):Introduction , study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations

Module III (9 hours)

Electrochemical machining (ECM):Introduction , study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations
Chemical Machining (CHM) :Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: ;material removal rate accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

Module IV (8 hours)

Electrical discharge machining (EDM): introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear , EDM tool design choice of machining operation electrode material selection, under sizing and length of electrode , machining time. Flushing pressure flushing suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy surface finish, Heat affected Zone. Machine tool selection, Application EDM accessories / applications, electrical discharge grinding, Traveling wire EDM.

Module V (9 hours)

Plasma Arc Machining (PAM):Introduction, equipment non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations.
Laser Beam Machining (LBM):Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.
Electron Beam Machining (EBM): Principles, equipment, operations, applications, advantages and limitation of EBM.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. P.C. Pandey & H.S. Shan, Modern Machining Process, Tata McGraw Hill
2. Bhattacharaya , New Technology,2000

Reference Books

1. P.K.Mishra, Non-Conventional Machining, The Institution of Engineers (India) Test book series, Narosa Publishing House – 2005.
2. ADITYA, Modern Machining Process, 2002
3. Joseph R. Davis, Metals Handbook: Machining(Hardcover) Volume 16, American Society Of Metals (ASM)
4. Production Technology, by HMT TATA McGraw Hill. 2001

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 3 marks=15 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer five questions out of seven. There should be at least one question from each module and not more than two questions from any module.	*5 x 5 marks=25 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*5 x 12 marks=60 marks*

Maximum Total Marks: 100

AU 010 707 Mechanical Measurements Laboratory

Teaching scheme **Credits:** 2

3 hours practical per week

Objectives

- *To provide an exposure to the fundamentals of metrology*
- *To understand the need of precision measurement and measuring instruments*

1. Study and use of laser interferometer for calibration of linear measurements.
2. Study of slip gauges – wringing – surface roughness - standards.
3. Study of surface plates, straight edges, angle plate, V-block etc and applications.
4. Measurement of out of roundness using roundness measuring instrument, V block and dial indicator etc. - reasons for out of roundness etc.
5. Measurements of straightness using sprit level and auto collimator.
6. Measurement of thread parameters using three wire method.
7. Measurement of tool angles of single point tool using tool maker's microscope.
8. Measurement of gear parameters using profile projector.
9. Evaluation of straightness error using autocollimator, sprit level, straight edge etc.
10. Calibration and determination of uncertainties of the following;
    a. Strain gauge load cells
    b. Bourdon tube pressure gauge
    c. LVDT
    d. Thermocouples
    e. Tachometers and stroboscopes, etc.
11. Study and measurement of surface roughness using surface roughness instrument.
12. Study and measurements with coordinate measuring machines.
13. Experiments on limits and fits.
14. Study and use of ultrasonic flaw detector.
15. Study of different types of dial indicators - stands and holders for dial gauges.
16. Study and use of different types of comparators.
17. Exercises on measurement system analysis
18. Study and making measurements with precision vernier calipers, dial calipers, spline micrometer, point micrometer, wire groove micrometer, depth micrometer, V- anvil micrometers, depth gear tooth micrometer, thread micrometer, disc micrometer, thread pitch gauge, vernier height gauge, slip gauges, optical flat, three pin micrometer, pyrometer, RTD, bore dial gauge, depth gauge, pitch gauge, thickness gauge, radius gauge, hole test, bench center etc.
19. Angular measurements using bevel protractor, sine bar, clinometers etc.

20. Measurement of vibration.
21. Analysis of automobile exhaust gas and flue gas.
22. Study and determination of area using planimeter.
23. Polishing, etching and determination of grain size and microstructure studies using optical microscope.

TEXT BOOKS:

1. Sharp K.W.B., Practical Engineering Metrology, Sir Isaac Pitman and sons Ltd, London, 1958.
2. Shotbolt C.R. and Gayler J.F.W, Metrology for Engineers, 5th edition, ELBS, London.

REFERENCE BOOKS:

1. Figliola, Richard S, and Beasley, Donald E, "Theory and Design for Mechanical Measurements", Third edition, John Wiley and Sons Inc.
2. Collett, C.V. and Hope, A.D, "Engineering Measurements", Second edition, ELBS/Longman.
3. Tarasevigh Y. and Yavosih E., Fits, Tolerances and Engineering Measurements, Foreign language publishing house, Moscow.

AU010 708

AUTOMOBILE WORKSHOP – II

Teaching scheme Credits: 2
3 hour practical per week

1. Study and practice on air compressor
2. Study and practice on two post lift
3. Measuring CO, HC, CO , O2 , NOx of gasoline engine with exhaust gas analyzer
4. Checking the emission of diesel engine with diesel smoke meter.
5. Engine Valve reconditioning: Valve grinding by using valve re-facing machine, valve seat grinding, lapping and valve angle cutting.
6. Cylinder reconditioning: Checking the cylinder bore, setting the tool, re-boring operation using vertical cylinder reboring machine.
7. Line boring: measure bore , setting bore , Setting the tool, line boring using horizontal line boring machine
8. Tyre removing, inspection, check for cuts, bulges and excessive tread wear, resetting using pneumatic tyre changer & Wheel balancing: Balancing of wheels by computerized wheel balancing machine.
9. Wheel alignment: Checking the camber, caster, king pin inclination, toe in and toe out with computerized wheel alignment machine.
10. F. I. P Calibration and phasing: Setting the angle of fuel delivery, calibration of fuel quantity by FIP calibrating machine.
11. Brake drum re-conditioning: Brake drum skimming after leveling machine, ovality measurement and setting the tool.
12. Connecting rod boring: Con-rod boring, groove cutting, setting the tools, machinery. (Work with co-rod re-boring machine)
13. Testing of Two wheeled vehicles on chassis dynamometer
14. Setting of ignition timing of vehicles .
15. Testing auto electrical components:
    a. Testing with growler.
    b. Testing and checking of spark plugs with spark plug cleaner & testing machine
    c. Testing of ignition coil.
    d. Battery testing – specific gravity test , open volt test , HED test

AU 010 709 Seminar

Teaching scheme **credits: 2**

2 hours practical per week

The seminar power point presentation shall be fundamentals oriented and advanced topics in the appropriate branch of engineering with references of minimum seven latest international journal papers having high impact factor.

Each presentation is to be planned for duration of 25 minutes including a question answer session of five to ten minutes.

The student's internal marks for seminar will be out of 50. The marks will be awarded based on the presentation of the seminar by the students before an evaluation committee consists of a minimum of 4 faculty members. Apportioning of the marks towards various aspects of seminar (extent of literature survey, presentation skill, communication skill, etc.) may be decided by the seminar evaluation committee.

A bona fide report on seminar shall be submitted at the end of the semester. This report shall include, in addition to the presentation materials, all relevant supplementary materials along with detailed answers to all the questions asked/clarifications sought during presentation. All references must be given toward the end of the report. The seminar report should also be submitted for the viva-voce examination at the end of eighth semester.

For Seminar, the minimum for a pass shall be 50% of the total marks assigned to the seminar.

AU 010 710 Project Work

Teaching scheme **credits: 1**

1 hour practical per week

Project work, in general, means design and development of a system with clearly specified objectives. The project is intended to be a challenge to intellectual and innovative abilities and to give students the opportunity to synthesize and apply the knowledge and analytical skills learned in the different disciplines.

The project shall be a prototype; backed by analysis and simulation etc. No project can be deemed to be complete without having an assessment of the extent to which the objectives are met. This is to be done through proper test and evaluation, in the case of developmental work, or through proper reviews in the case of experimental investigations.

- The project work has to be started in the seventh semester and to be continued on to eighth semester.
- Project work is to be done by student groups. Maximum of four students only are permitted in any one group.
- Projects are expected to be proposed by the students. They may also be proposed by faculty member (Guide) or jointly by student and faculty member.
- Students are expected to finalise project themes/titles with the assistance of an identified faculty member as project guide during the first week of the seventh semester.

The progress from concept to final implementation and testing, through problem definition and the selection of alternative solutions is monitored. Students build self confidence, demonstrate independence, and develop professionalism by successfully completing the project.

Each student shall maintain a project work book. At the beginning of the project, students are required to submit a project plan in the project book. The plan should not exceed 600 words but should cover the following matters.

- ❖ Relevance of the project proposed
- ❖ Literature survey
- ❖ Objectives
- ❖ Statement of how the objectives are to be tackled

- Time schedule
- Cost estimate

These proposals are to be screened by the evaluation committee (EC- minimum of 3 faculty members including the guide) constituted by the head of department, which will include a Chairman and the EC will evaluates the suitability and feasibility of the project proposal. The EC can accept, accept with modification, request a resubmission, or reject a project proposal.

Every activity done as part of project work is to be recorded in the project book, as and when it is done. Project guide shall go through these records periodically, and give suggestions/comments in writing in the same book.

The students have to submit an interim report, along with project work book showing details of the work carried out by him/her and a power point presentation at the end of the 7^{th} semester to EC. The EC can accept, accept with modification, request a resubmission, or extension of the project.

The student's internal marks for project will be out of 50, in which 30 marks will be based on day to day performance assessed by the guide. Balance 20 marks will be awarded based on the presentation of the project by the students before an evaluation committee consists of a minimum of 3 faculty members including the guide.

For Project, the minimum for a pass shall be 50% of the total marks assigned to the Project work.

AU010 801 Design of Transmission Elements
(Common with ME010 801)

Teaching scheme **Credits:** 4

2 hours lecture, 2 hour tutorial and 1 hour drawing per week

Objectives

To provide basic design skill with regard to various transmission elements like clutches, brakes, bearings and gears.

Module I (20 Hrs)

Clutches - friction clutches- design considerations-multiple disc clutches-cone clutch- centrifugal clutch - Brakes- Block brake- band brake- band and block brake-internal expanding shoe brake.

Module II (17 Hrs)

Design of bearings - Types - Selection of a bearing type - bearing life - Rolling contact bearings - static and dynamic load capacity - axial and radial loads - selection of bearings - dynamic equivalent load - lubrication and lubricants - viscosity - Journal bearings - hydrodynamic theory - design considerations - heat balance - bearing characteristic number - hydrostatic bearings.

Module III (19 Hrs)

Gears- classification- Gear nomenclature - Tooth profiles - Materials of gears - design of spur, helical, bevel gears and worm & worm wheel - Law of gearing - virtual or formative number of teeth- gear tooth failures- Beam strength - Lewis equation- Buckingham's equation for dynamic load- wear load- endurance strength of tooth- surface durability- heat dissipation - lubrication of gears - Merits and demerits of each type of gears.

Module IV (16 Hrs)

Design of Internal Combustion Engine parts- Piston, Cylinder, Connecting rod, Flywheel

Design recommendations for Forgings- castings and welded products- rolled sections- turned parts, screw machined products- Parts produced on milling machines. Design for manufacturing - preparation of working drawings - working drawings for manufacture of parts with complete specifications including manufacturing details.

Note: Any one of the following data book is permitted for reference in the final University examination:

1. Machine Design Data hand book by K. Lingaiah, Suma Publishers, Bangalore/ Tata Mc Graw Hill
2. PSG Design Data, DPV Printers, Coimbatore.

Text Books

1. C.S,Sarma, Kamlesh Purohit, Design of Machine Elements Prentice Hall of India Ltd NewDelhi
2. V.B.Bhandari, Design of Machine Elements McGraw Hill Book Company
3. M. F. Spotts, T. E. Shoup, Design of Machine Elements, Pearson Education.

Reference Books

1. J. E. Shigley, Mechanical Engineering Design, McGraw Hill Book Company.
2. Juvinall R.C & Marshek K.M., Fundamentals of Machine Component Design, John Wiley
3. Doughtie V.L., & Vallance A.V., Design of Machine Elements, McGraw Hill Book Company.
4. Siegel, Maleev & Hartman, Mechanical Design of Machines, International Book Company.

AU010 802 Operations Management
(Common with ME010 802)

Teaching scheme

Credits: 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *To familiarize the main decision making scenarios (strategic, tactical and operative) an Operations Manager may come across.*
- *To develop an understanding of the main OM principles, techniques and tools to analyze, diagnose and then to improve processes.*

Module I (12 hours)

Introduction to Operations Management- Functions of Operations Management, Strategic, Tactical and Operational decisions. Forecasting in decision making: Factors affecting forecasting, Sources of data, Time series analysis, Demand patterns, Forecasting methods- Moving average, Regression, Exponential smoothing-problems, Qualitative methods- Measures of forecast accuracy.

Module II (12 hours)

Aggregate Planning: Aggregate planning strategies and methods, Transportation model for aggregate planning. Master Production Schedule- Materials Requirement Planning, Bill of materials, Lot sizing in MRP, MRP-II, CRP, DRP.

Module III (12 hours)

Introduction to Scheduling: Single machine scheduling, Flow shop scheduling, Job shop scheduling. Sequencing: Johnson's algorithm, Processing *n* jobs through two machines, processing *n* jobs through three machines, processing *n* jobs through *m* machines, processing two Jobs through *m* machines-problems.

Module IV (12 hours)

Maintenance Planning and Control: Types of maintenance, Need for replacement, Replacement problems, Individual replacement policy, Group replacement policy, TPM. Reliability – Bath tub curve- reliability improvement, Measures for maintenance performance, reliability calculations, FMECA, information system for maintenance management.

Module V (12 hours)

Modern concepts/ techniques in operations management: Just in time manufacturing, Lean manufacturing, Push Pull Production, Kanban systems, Flexible manufacturing systems, ERP.

Supply Chain management: Supply chain, objective of Supply Chain, Supply chain macro processes, Process view of a supply chain, Drivers of Supply Chain.

Text Books

1. Mahadevan B., *Operations Management,* Pearson Education.
2. Panneerselvam R., *Production and operations Management*, Prentice Hall of India.

Reference Books

3. Krajewski and Ritzman, *Operations Management*, Pearson Education.
4. Verma A.P., *Industrial Engineering*, S. K. Kataria & Sons.
5. Adam and Ebert, *Production and Operations Management*, Prentice Hall of India.
6. Chopra and Meindl, *Supply Chain Management*, Prentice Hall of India.

AU010 803 SPECIAL TYPES OF VEHICLES

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To illustrate the special types of vehicles , its operation and controls*

Module I (12 hours)

Tyre and tracked vehicles , advantages and disadvantages, under carriage components like , tracks, roller frames, drive sprockets, track rollers, track chains and track shoes. Suspension: rubber spring suspension and air spring suspension. Steering of tracked vehicles: Skid steering , articulated steering, clutch /brake steering system, controlled differential steering system and planetary steering system.
Final drives: types of reductions like, single reduction, double reduction final drive and planetary final drives, PTO shaft
Basic components of hydraulic systems like pumps (types of pumps), control valves like flow control valves, directional control valves and pressure control valves, hydraulic motors and hydraulic cylinders.

Module II (12 hours)

Excavators: General description, specification and functions, classification based on attachments, face shovel, drag shovel, hoe, drag-line and grab or clam shell, advantages and limitations.
Graders: Description, specification of tractor towed graders and motor graders, classification and functions of graders, functional details of spreading, mixing, ditching, bank sloping, snow removal, stripping, scarifying, and finishing, elementary details of transmission system (coupling, clutches, gear box, driving axles, propeller shafts), running gear and operating equipment, air braking system.

Module III (12 hours)

Haulage vehicles: General description, specification and functions, self-propelled and tractor towed haulage vehicles, dumpers – front tipping; trucks – rear tipping, tractor towed semi-trailers and trailers (rear and side tipping, bottom dumping).
Lift trucks: General description, specification and functions, fork lift trucks, alternative front end equipment (attachments) – jib arm, shovel bucket, squeeze clamp, boom, fork extensions, barrel forks. Scissors lift trucks - applications in industry, advantages and disadvantages.

Module IV (12 hours)

Cranes: General description, specifications and functions, excavator mounted cranes, mobile cranes with strut and cantilever type jibs, tractor towed and tractor mounted cranes.
Compaction vehicles: General description, specification and functions, smooth wheeled rollers, pneumatic tired rollers, agricultural Rollers, sheep's foot rollers; vibrating compactors.

Module V (12 hours)

Scrapers: General description, specification and functions, tractor towed and motorized scrapers, scraper work in cutting, cambering, side hill cutting, spreading on embankments,

compaction of fill merits and demerits.
Tractors: General description, specification and functions, light, medium and heavy wheeled tractors, crawler tracks mounted / wheeled-bull dozers, tilt dozers and angle dozers, front end loaders, factors affecting efficiency of output of tractors, simple problems, merits and demerits. Productivity & operating capacity of dozer.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Wong J Y, "Theory of Ground Vehicles",John Wiley & Sons, New York, 1978.
2. Ian Andrew Norman, "Heavy Duty Vehicle systems", third edition, Delmar-Thomson
3. S.C. Sharma, Construction equipment and its management

Reference Books

1. Herbert Nicholas, Moving the earth
2. Donald R. hunt and L. W.garner, Farm machinery and mechanism
3. Wong J Y, "Theory of Ground Vehicles"
4. Roninson E G, "Motor Graders", MIR Publications, Moscow – 1985.
5. Heinz Heisler, "Vehicle and Engine Technology" second edition, SAE-1999, USA.
6. Rodhiev and rodhiev, "Tractors and Automobiles" MIR Publishers, Moscow, 1984.
7. Greenwich and Soreking, "Tractors", MIR Publishers, Moscow-1967

AU010 804L01: TRANSPORT REFRIGERATION AND AIR CONDITIONING

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of automobile air conditioning*

Module I (12 hours)

Air conditioning Fundamentals: Basic air conditioning system,- Air conditioning principles, Air-conditioning types, temperature and pressure fundamentals, types of compressors and refrigerants.
Air Conditioning Systems Classification, layouts, central *I* unitary air conditioning systems, components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems, Automotive heaters, Types, Heater Systems, Air conditioning protection, Engine protection.

Module II (12 hours)

Load Analysis: Outside& inside design consideration, factors forming the load on refrigeration & air conditioning systems,cooling & heating load calculations, load calculations for automobiles, effect of air conditioning load on engine performance.

Module III (12 hours)

Air Distribution Systems**:** Distribution duct system, sizing, supply *I* return ducts, type of grills, diffusers, ventilation, air noise level, layout of duct systems for automobiles and their impact on load calculations.

Module IV (12 hours)

Air Routing & Temperature Control: Objectives, evaporator air flow, through the re-circulating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control of air handling systems
Air Conditioning Control: Common control such *as* thermostats, humidistat, control dampers, pressure cut outs, relays

Module V (12 hours)

Air conditioning service: Air conditioner maintenance & service- causes of air conditioner failure, leak testing guide, discharging the system, Evacuating the system, charging the system, servicing heater system, removing & replacing components, trouble shooting of air conditioning system, compressor service, methods of dehydration, charging & testing.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Mark Schnubel, “Automotive Heating & Air Conditioning", Thomson Delmar Learning, 3rd edition, NY.
2. William H. Crouse & Donald L. Anglin, "Automotive Air Conditioning. McGrawHill, Inc.
3. ASHRAE Handbook-1985 Fundamentals

Reference Books

1. Boyace H. Dwiggins, ”Automotive Air – conditioning”
2. SamSugarman, “HVAC Fundamentals. Fairmont Press, ISBN0-88173-489-6.
3. Paul Weisler, "Automotive Air Conditioning, Reston PublishingCo.Inc.1990.
4. Paul Lung, "Automotive Air Conditioning, C.B, S. Publisher & Distributor, Delhi.
5. MacDonald K. L “ Automotive Air Conditioning “, TheodoreAudel series, 1978

AU010 804L02 ENGINEERING ECONOMICS AND AUTOMOTIVE COST ESTIMATION

Teaching scheme **Credits**: 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of engineering economics and automotive cost estimation.*

Module I (12 hours)

Introduction: Definition of various economic terms such as economic goods, utility, value, price, wealth, Attributes of wealth and its classification, wants and their characteristics, Classification of wants, standard of living, rent and profit, Factors of Production: Land, Lab our, Capital, Organization.
Demand and Supply: Law of diminishing utility, marginal and total utility, Demand, Demand Schedule, Law of demand, Elasticity of demand, Factors governing the elasticity of demand, Law of substitution and its application, Supply, Law of supply, supply schedule, elasticity of supply, theory of value, equilibrium price, Laws of returns.
Wages: Nominal and real wages, Factors affecting real wages, Wages, efficiency and standard of living, theory of wages, difference in wages, methods of wage payment

Module II (12 hours)

Money and Exchange: Definition and function of money, Qualities of a good money, classification of money, value of money, index numbers, appreciation and depreciation of money, Gresham's Law and its limitations. Theory of exchange, barter, stock exchange, Speculation
Taxation and Insurance: Principle of taxation, characteristics of a good taxation system, kinds of taxes and their merits and demerits, Vehicle Insurance and loss Assessment
Interest: Introduction, theory of interest, interest rate, interest rate from lender's and borrower's view point, simple and compound interest, Cash Flow Diagram, Interest formulas (discrete compounding, discrete payments), Nominal and effective interest rates, Numerical problems.

Module III (12 hours)

Depreciation: Need for depreciation, Causes of depreciation, Life and salvage value, Methods of calculating depreciation and their merits and demerits, Numerical problems.
Replacement analysis: Basic reasons for replacement, present asset and its replacement, consideration leading to replacement, installation and removal cost, Numerical problems.
Basis for Comparison of alternatives: Present worth, equivalent annual worth, future worth, rate of return, payback period, capitalized cost comparison, and capital recovery with return methods, Numerical problems.

Module IV (12 hours)

Costs and Cost Accounting: Standard cost, estimated cost, First cost, Fixed cost, Variable cost, Incremental cost, Differential cost, Sunk and marginal cost, Breakeven and minimum cost analysis. Objectives of cost accounting, elements of cost: material cost, labor cost, and expenses, allocation of over heads by different methods, Numerical problems.
Book Keeping and accounts: Introduction, Necessity of book keeping, single entry and double entry system, Classification of assets, Journal, Ledger, Trial balance, Final accounts, trading, profit and loss account, Balance sheet, Numerical problems

Module V (12 hours)

Cost Estimation: Introduction, importance, objectives and functions of estimating, principle factors in estimating, Functions and qualities of an estimator, estimating procedure. Estimation of material cost and manufacturing cost of simple automotive components, Estimation of cost of overhauling and servicing of automotive components - cylinder, valves, valve seats, crankshaft, FIP, Brake drum, body building, different types of repairs, Numerical problems.
Make or buy decision, Value engineering – Function, aims, and Value engineering procedure.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Tara Chand, Engineering Economics
2. T. R. Banga and S. C. Sharma , Mechanical Estimating and Costing, Khanna Publishers

Reference Books

1. T. R. Banga and S. C. Sharma , Industrial Organization and Engineering Economics, Khanna Publishers, New Delhi
2. D. Kannappan , Mechanical Estimating and Costing, Tata McGraw Hill Publishing Company Ltd., New Delhi
3. O. P. Khanna , A Text Book of Mechanical Estimating and Costing, Dhanpat Rai Publications Pvt. Ltd., New Delhi
4. O. P. Khanna , Industrial Engineering and Management, , Dhanpat Rai and Sons
5. I. M. Pandey , Financial Management, , Vikas Publishing House Pvt. Ltd., New Delhi
6. James L. Riggs, David D. Bedworth and Sabah U. Randhawa , Engineering Economics, Tata McGraw-Hill Publishing Co. Ltd., New Delhi
7. Paul DeGarmo , Engineering Economy, , Macmillan International Inc., New York

AU010 804L03: VEHCILE DYNAMICS

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts about vibrations and how to reduce the vibration under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle.*

Module I (12 hours)

Fundamentals of vibration, single degree of freedom, two degree of freedom, multidegree freedom, free, forced and damped vibrations, magnification factor, transmissibility, vibration absorber
Dynamic force analysis: Inertia force, Inertia torque, determination of inertia forces – Engine mechanism, four bar mechanism, engine force analysis, dynamically equivalent masses, equiline output torque.
Performance of road vehicles: Tractive resistance, tractive effort, power required for propulsion, grade ability, drawbar pull and the problems related to these terms.

Module II (12 hours)

Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressuredistribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids,aerodynamic side force, lift force, pitching moment, yawing moment, rol ing moment, cross wind sensitivity, power for propulsion, traction and tractive effort, Road performance curves- acceleration, gradability and drawbar pull, acceleration time and elasticity.

Module III (12 hours)

Suspension: Vehicle dynamics and suspension requirements, choice of suspension spring rate, chassis springs and theory of chassis springs, Gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system, Roll axis and the vehicle under the action of side forces.

Module IV (12 hours)

Stability of vehicles: Load distribution(Three wheeled and four wheeled vehicles), calculation of acceleration, tractive effort and reactions for different drives, stability of a vehicle on a curved track, slope and a banked road.
Gyroscopic effects, weight transfer during acceleration and braking, stability of a rigid vehicle and equations of motion of a rigid vehicle, cross wind handling.
Braking requirements, stopping distance, braking efficiency, work done in braking, tyre adhersion

Module V (12 hours)

Tyres: tyre dynamics, ride characteristics, slip angle, power consumed by a tyre. Oversteer, under steer, steady state cornering, aligning moment-combined braking and cornering, effect of camber & transient effects in cornering. Tire vibrations

Road testing methods: Measurement of aerodynamic drag force in a coast – down test, cross wind tests, engine cooling road test, wind noise measurement on the road.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Rao J.S and Gupta. K "Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd.,
2. Giri N.K – Automotive Mechanics, Khanna Publishers, 2007.

Reference Books

1. W. Steeds – Mechanics of road vehicles – Wildlife book Ltd, London 1990.
2. J. G. Giles – steering, suspension and tyres, Wildlife books Ltd, London 1968.
3. P. M. Heldt – Automotive chassis, Chilton Co, New York, 1952.
4. J. Y. Wong – Theory of ground vehicles, Johnwiley and sons Inc., New York.

AU010 804L04: FINITE ELEMENT METHOD

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of finite element methods*

Module I (12 hours)

Introduction: Equilibrium equations in elasticity subjected to body force, traction forces, and stress-strain relations for plane stress and plane strains. General description of Finite Element Method, Application and limitations. Types of elements based on geometry. Node numbering, Half band width.
Basic Procedure: Euler - Lagrange equation for bar, beam (cantilever /simply supported fixed) Principle of virtual work, principle of minimum potential energy, Raleigh's Ritz method. Direct approach for stiffness matrix formulation of bar element. Galerkin's method.

Module II (12 hours)

Interpolation Models: Interpolation polynomials- Linear, quadratic and cubic. Simplex complex and multiplex elements. 2D PASCAL's triangle. CST elements-Shape functions and Nodal load vector, Strain displacement matrix and Jacobian for triangular and rectangular element.
Solution of 1-D Bars: Solutions of bars and stepped bars for displacements, reactions and stresses by using penalty approach and elimination approach. Guass-elimination technique.

Module III (12 hours)

Higher Order Elements: Langrange's interpolation, Higher order one dimensional elements-Quadratic and cubic element and their shape functions. Shape function of 2-D quadrilateral element-linear, quadric element Isoparametric, Sub parametric and Super parametric elements. Numerical integration : 1, 2 and 3 gauge point for 1D and 2D cases.

Module IV (12 hours)

Trusses: Stiffness matrix of Truss element. Numerical problems.
Beams: Hermite shape functions for beam element, Derivation of stiffness matrix. Numerical problems of beams carrying concentrated, UDL and linearly varying loads.

Module V (12 hours)

Heat Transfer: Steady state heat transfer, 1D heat conduction governingequations. Functional approach for heat conduction. Galerkin's approach for heat conduction. 1D heat transfer in thin fins.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. T.R.Chandrupatla, A.D Belegunde , Finite Elements in Engineering, , 3rd Ed PHI.
2. S.S. Rao , Finite Element Method in Engineering, , 4th Edition, Elsevier, 2006.

Reference Books

1. U.S. Dixit , Finite Element Methods for Engineers", Cengage Learning, 2009
2. R.D. Cook D.S Maltus, M.E Plesha, R.J.Witt , Concepts and applications of Finite Element Analysis, Wiley 4th Ed, 2009
3. Daryl. L. Logon , Finite Element Methods, Thomson Learning 3rd edition, 2001.
4. J.N.Reddy , Finite Element Method, McGraw -Hill International Edition.

AU010 804L05: MICROPROCESSOR APPLICATION IN AUTOMOBILES

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of microprocessor applications in automobiles*

Module I (12 hours)

Architecture: General 8 bit micropocessor and its architecture 8085, Z-80 and MC 6800 MPU and its pin function - Architecture - Function of different sections.

Module II (12 hours)

Instruction Set : Instruction format - addressing modes - insruction set of 8085 MPU-T-STATE - Machine cycle and instruction cycles - Timing diagrams - Different machine cylces - Fetch and execute operations - estimation of execution times.

Module III (12 hours)

Assembly Language Programmimg**:** Construct of the language programming - Assembly format of 8085 - Assembly Directive - Multiple precision addition and subtraction - BCD to Binary and Binary to BCD, Multiplication, Division, Code conversion using look up tables - Stack and subroutines.

Module IV (12 hours)

Data Transfer Schemes**:** Interrupt structure - Programmed I/O - Interrupt driven I/O, DMA - Serial I/O.
Interfacing Devices: Types of interfacing devices - Input / Output ports 8212, 8255, 8251, 8279. Octal latches and tristate buffers - A/D and D/A converters - Switches, LED's ROM and RAM interfacing. Address space partitioning , memory interfacing

Module V (12 hours)

Applications: Data acquisitions - Temperature control - Stepper motor control - Automotive applications Engine control, Suspension system control, Driver information systems), Development of a high speed, high precision learning control system for the engine control.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Ramesh, Goankar.S., " Microprocessor Architecture Programming and Applications ", Wiley Eastern Ltd., New Delhi, 1986.

Reference Books

1. Aditya.P.Mathur, " Introduction to Microprocessors ", III Edition, Tata McGraw-Hill Publishing Co Ltd., New Delhi, 1989.
2. Ahson.S.I. " Microprocessors with Applications in Process Control ", Tata McGraw-Hill,New Delhi, 1986.
3. SAE Transactions, 1986 Sec 3.
4. Jabez Dhinagar.S., " Microprocessor Application in Automoblies ".
5. L.Bianco and A.Labella., " Automotive Micro Electronics ", Elsevier science publishers. 1986.

AU010 804L06: FOUNDRY AND WELDING TECHNOLOGY

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of foundry and welding technology.*

Module I (12 hours)

Introduction: Concept of Manufacturing process, its importance. Classification of Manufacturing processes. Introduction to Casting process & steps involved. Varieties of components produced by casting process. Advantages & Limitations of casting process.
Patterns: Definition, functions, Materials used for pattern, various pattern allowances and their importance. Classification of patterns, BIS color coding of Patterns. Binder: Definition, Types of binder used in moulding sand. Additives: Need, Types of additives used and their properties..

Module II (12 hours)

Sand Moulding : Types of base sand, requirement of base sand. Moulding sand mixture ingredients for different sand mixtures. Method used for sand moulding, such as Green sand, dry sand and skin dried moulds. Cores: Definition, Need, Types. Method of making cores, Binders used, core sand moulding. Concept of Gating & Risers. Principle and types. Fettling and cleaning of castings. Basic steps, Casting defects, Causes, features and remedies. Moulding Machines : Jolt type, Squeeze type, Jolt & Squeeze type and Sand
slinger.

Module III (12 hours)

Special moulding Process: Study of important moulding processes, No bake moulds, Flaskless moulds, Sweep mould, CO2 mould, Shell mould, Investment mould. Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixo-casting and Continuous Casting Processes. Melting Furnaces: Classification of furnaces. Constructional features & working principle of coke fired, oil fired and Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.

Module IV (12 hours)

Welding process: Definition, Principles, Classification, Application, Advantages & limitations of welding. Arc Welding: Principle, Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes. (AHW) Gas Welding: Principle, Oxy – Acetylene welding, Chemical Reaction in
Gas welding, Flame characteristics. Gas torch construction & working. Forward and backward welding.
Special types of welding: Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.

Module V (12 hours)

Metallurgical aspect, in welding : Structure of welds, Formation of different zones during welding. Heat affected zone (HAZ). Parameters affecting HAZ. Effect of carbon content on structure and properties of steel. Shrinkage in welds & Residual stresses. Concept of electrodes, Filler rod and fluxes. Welding defects – Detection causes & remedy.
Principles of soldering & brazing: Parameters involved & Mechanism. Different Types of Soldering & Brazing Methods. Inspection Methods – Methods used for Inspection of casting and welding.
Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy current, Holography methods of Inspection.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Dr.K.Radhakrishna, Manufacturing Process, Sapna ,5th Revised Edition 2009.
2. P.N.Rao , Manufacturing & Technology: Foundry Forming and Welding, 3rd Ed., Tata McGraw Hill, 2003.

Reference Books

1. Roy A Lindberg, Process and Materials of Manufacturing, 4th Ed.Pearson Edu. 2006.
2. Serope Kalpakjian, Steuen. R. Sechmid , Manufacturing Technology ,Pearson Education Asia, 5th Ed. 2006.

AU010 805G01: SYSTEM MODELING AND SIMULATION

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To provide knowledge about simulation of IC Engines Process.*
- *To provide knowledge about modeling of IC Engines Process.*

Module I (12 hours)

Introduction & Combustion in SI Engines: First law and second law analysis, governing equation, conservation of mass, momentum and energy. Combustion in SI Engines: Combustion in premixed flames - stages of combustion, flame propagation, rate of pressure rise, cycle-to-cycle variation, abnormal combustion - theories, effect of engine operating variables on combustion.

Module II (12 hours)

Combustion in CI Engines: Combustion in diffusion flames - droplet and spray combustion theory, stages of combustion, delay period, peak pressure, heat release, gas temperature, diesel knock

Module III (12 hours)

Modeling of IC Engines: Heat of reaction - HRP & URP calculations, adiabatic, constant volume combustion, constant pressure combustion, temperature drop due to fuel vaporization, adiabatic flame temperature, mean effective pressure, torque and thermal efficiency at full throttle, part throttle and supercharged conditions. Spray models, flow models and combustion models

Module IV (12 hours)

Simulation of IC Engines: SI & CI engine simulation – air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – part throttle, full throttle and supercharged conditions

Module V (12 hours)

Simulation of new Engine Concepts: Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine, controlled auto ignition engine.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Ganesan V, “Internal Combustion Engineering”, Tata McGraw Hill Publishing Co.

Reference Books

1. Ganesan V, “Computer Simulation of spark ignition engine process”, University Press (I) Ltd, Hyderabad.
2. Ganesan V, “Computer Simulation of compression ignition engine process”, University Press (I) Ltd, Hyderabad.
3. Heywood J B, “Internal Combustion Engine Fundamentals” McGraw Hill Book Co., USA2001.
4. Ramoss A L, "Modeling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992.
5. Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley & Sons, New York, 1986.
6. Benson R S, whitehouse.N.D., "Internal Combustion Engines", Paragon Press, oxford, 1979.
7. Ashley S Campbell, “Thermodynamic analysis of combustion engines”, John Wiley and sons, 1980

AU010 805G02: ROBOTICS AND ROBOT APPLICATION

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart knowledge on basics of robots and its application*

Module I (12 hours)

Introduction: Automation and robotics, Brief history of robotics, Development in robotics, Economics aspects of robots, Advantage and disadvantage of using robots in industries. Overview of robots – Present and future applications in automobile companies.
Production Design for Robotic Assembly: Production design for robotic and automatic assembly, consideration for assembly oriented product design. Robot safety.

Module II (12 hours)

Classification and structure of robotic system: .Classification, Geometrical configurations, wrist and its motions, End effectors and its type, links and joints.
Robot drive system: – Hydraulic, Electric and pneumatic drive system, Resolution, accuracy and repeatability, Advantage and disadvantage of drive system.

Module III (12 hours)

Control system and components: Basic control system concept and models, Transfer function and block diagram of spring mass system, Controllers – proportional, proportional and integral, proportional and derivative, PID, transient and response to second order system. Robot actuation and Feedback component – position, velocity sensors.

Module IV (12 hours)

Robot arm kinematics: Introduction, Direct and inverse kinematics, rotation matrix, rotation matrix about an arbitrary axis, Homogeneous transformation, links, joint and their parameters, D-H representation.
Trajectory Planning: Introduction, general consideration on trajectory planning, joint interpolated trajectory, planning of Cartesian path trajectories

Module V (12 hours)

Robot programming and languages: introduction, manual teaching, lead through teaching, programming language – AML and VAL, storing and operating, Task programs.
Sensors: Internal state sensors, tactile sensor, proximity sensing, range sensing, force torque sensor, elements of computer vision, sensing and digitizing function in machine vision- sampling- quantization-encoding-image storage. Image processing and analysis, feature extraction and object recognition. Artificial intelligence

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Mikell P. Groover, Mitchell Weiss, Industrial Robotics, Technology, Programming, and Applications, McGraw Hill International Editions, 1986.
2. K. S. Fu., R. C.Gonalez, C. S. G.Lee, Robotics Control Sensing, Vision and Intelligence, McGraw Hill International Edition.

Reference Books

1. Y.Koren, Robotics for Engineers, McGraw hill.
2. P.G.Ranky and C.Y.Ho, Robots Modeling Control and Applications with Software, Springer Verlag Berlin.
3. S.R.Deb , Robotics Technologies and Flexible Automation, TMH.
4. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, Robotic Engineering – An Integrated Approach, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.
5. V. Tergan, I. Andreev, B. Liberman, Fundamentals of Industrial Automation,

AU010 805G03: FARM MACHINERY AND EQUIPMENT

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To provide knowledge about various farm machinery and equipments.*

Module I (12 hours)

Tractors: Design and Operating principles of Engine transmission and control systems. Working details of different types of attachment in the tractor, Tillage, Soil structure, Moisture, Temperature and aeration , Destruction of weeds and posts, Types of tractor plough, Life Mechanisms.

Module II (12 hours)

Pumps and Spraying machinery : Types of pumps and their selection, Installation and working details, Regulating arrangements spraying machinery Spray pumps,Nozzles,Vibrated broom distribution, Spray materials, Types of field crop sprayers, Aircraft spraying, Dusting machines .

Module III (12 hours)

Earth moving equipments: Drainage Excavators, Ditching equipments, trench cutting machines, Bull dozers, Angle dozers, Earth scooper, graders, tractor winches, Road sweepers, Slurry scrappers .Working details of machinery like Cultivators, harro weeding equipments, land levellers, seed drills, grass seed drills, Ridgers,Gapping or thinning machines, Manure distributors, Speeders ,Lawn movers, Rotary grass cutters , Hay leaders, Silage and silage machinery,Winnowers,Combined clearing and grading machinery.

Module IV (12 hours)

Machinery for milk production: Essentials of milking machines, Types of milking plane, Bucket , direct to churn milking parlours, Bulk handing milking bails, Milk cooling and serialisation, Cream separators .Testing of Machinery, H.P. Developed, other performance tests and testing equipments , wear testing , life testing, Tractor draw bar performance curves, Characterises curves for pumps, Maintenance Engineering, Servicing, check up, spare parts, stand by spare parts requirements, Service workshop, Organisation and management, Labour and Machinery required

Module V (12 hours)

Methods of Selection of Equipments based on the Selection of machines, Basic rules of equipments including the nature of operation, Selection based on type of soil, Selection based on haul distance, Selection based on weather condition
Calculation of Operating Capacity: Methods of calculating operating capacity, Calculation of productivity of a bull dozer

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Construction equipment and its management By S.C. Sharma
2. Donald R. hunt and L. W.garner, Farm machinery and mechanism

Reference Books

1. Rodichev and G.Rodicheva, "Tractor and Automobiles ", MIR Publishers,
2. Kolchin.A., and V.Demidov "Design of Automotive engines for tractor ", MIR Publishers
3. Guruvech and Sorekin- Tractors, MI1R Publishers Moscow
4. Geleman and M. Maskovin- Farm tractors, MIR. Publishers, Moscow
5. Smith , Harris Pearson & Wilkes, Lambert Henry- Farm machinery and equipment, TATA McGraw Hill Publications
6. Herbert Nicholos- Moving the earth.

AU010 805G04: AEROSPACE ENGINEERING

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the concepts of aerospace engineering.*
- *To develop understanding about aerofoil theory and airplane performance.*

Pre-requisites: *Basic knowledge of fluid mechanics and gas dynamics*

Module I (12 hours)

Review of gas dynamics: Control volume analysis, continuity, momentum and energy equations. Static, dynamic and stagnation conditions. Phenomena in supersonic flow. The atmosphere: Characteristics of troposphere, stratosphere, mesosphere and ionosphere. International Standard Atmosphere – Pressure, Temperature and Density variations in the International Standard Atmosphere

Module II (12 hours)

Equations for incompressible inviscid flows: Circulation and vorticity - Kelvin's theorem – velocity potential and stream function. Elementary flow patterns and their superposition. Blasius theorem. Flow past a cylinder, magnus effect, kutta condition, vortex theory of lift. Conformal transformation, Jowkowski transformation.

Module III (12 hours)

Theory of aerofoil: Application of dimensional analysis to viscous flow over bodies – aerofoil geometry – lift, drag and moment equations, characteristic curves, low theory, symmetric aerofoil, tear drop theory. Wave drag of aerofoil – The NACA aerofoils. Theory of propeller – momentum and blade element theory, propeller characteristics.
Aircraft engines – Turbojet, turbo fan and Ram jet engines – Bypass and Afterburners.

Module IV (12 hours)

Straight and level flight – stalling speed, minimum drag and maximum power conditions, performance curves. Gliding – gliding angle and speed of fastest glide. Climbing – rate of climb, take off and landing performance, length of runway required. Circling flight, banked flight, range and endurance of airplanes.

Module V (12 hours)

Aircraft instruments – airspeed indicators – calculation of true airspeed, altimeters, rate of climb meter, gyro compass.Principles of wind tunnel testing – Open and closed type Wind tunnels – Pressure and velocity measurements – Supersonic Wind tunnels (description only) – Rocket motors – Solid and liquid propellant rockets – Calculation of earth orbiting and escape velocities ignoring air resistance and assuming circular orbit.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. J. D. Anderson Jr., Fundamentals of Aerodynamics, McGraw Hill.

Reference Books

1. Dommasch, Airplane Aerodynamics.
2. A. C. Kermode, Mechanics of Flight.
3. Houghton, Brock, Aerodynamics for Engineering Students.

AU010 805G05: MANAGEMENT INFORMATION SYSTEMS

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To provide knowledge about various methods and the influence of the information systems in management and use of MIS as an effective tool in managers decision making.*

Module I (12 hours)

Organization & Types, Decision Making, Data & information, Characteristics & Classification of information, Cost & value of information, various channels of Information. framework for information systems - systems approach - systems concepts - systems and their environment - effects of system approach in information systems design - using systems approach in problem solving - strategic uses of information technology

Module II (12 hours)

Foundation of Information System: Introduction to Information System in Business Fundamentals of Information System, Solving Business Problems with Information System, Concept of Balanced MIS, Effectiveness & Efficiency Criteria. Tool and Techniques of MIS-dataflow diagram, flow chart etc.
An overview of computer hardware and software components - file and database management systems - introduction to network components - topologies and types - remote access - the reasons for managers to implement networks - distributed systems.

Module III (12 hours)

Business application of information technology, electronic commerce, Internet, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations, Information system for managerial Decision Support. Tactical and strategic areas of management, decision support systems and expert systems

Module IV (12 hours)

Information systems planning - critical success factor - business system planning - ends/means analysis - organizing the information systems plan - systems analysis and design - alternative application development approaches - organization of data processing - security and ethical issues of information systems
Managing Information Technology, Enterprise & Global Management. Reports: Various types of MIS reports, GUI & Other Presentation tools.

Module V (12 hours)

Advanced concepts in information system: Enterprise Resource Planning: introduction, various modules like Human Resources, Finance, Accounting, Production & Logistics. Supply Chain Management, CRM, Procurement Management System Object Oriented modeling case studies.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. O.Brian, Introduction to Information System, Mc-Graw Hill.
2. Robert Schultheis & Mary Sumner, Management Information Systems-The Manager's View, Tata McGraw Hill.

Reference Books

1. Laudon K.C. & Laudon J.P, Management Information Systems - Organization and Technology, Prentice Hall of India
2. Sadagopan S, Management Information Systems, Prentice Hall of India
3. Basandra S.K, Management Information Systems, Wheeler Publishing.
4. Alter S, Information Systems: A Management Perspective, Addison Wesley.
5. Effy Oz, Management Information Systems, Thomson, Vikas Publishing House
6. Arora & Bhatia, “Information Systems for Managers”, Excel
7. Bansal, “Information System Analysis & Design”, TMH.
8. Jawadegar, “Management Information System”, TMH.
9. Murdick, “Information System for Modern Management”, PHI.

AU010 805 G06 Petrochemical Engineering

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

• *To impart the basic concepts of science of petroleum drilling and transportation of oil.*

EXPLORATION AND DRILLING

Module 1 (12 Hours)

Methods of petroleum prospecting and exploration such as geophysical, seismic, etc. - drilling equipments such as rigs, platforms etc - techniques for offshore and onshore operation.

Directional Drilling: Objectives, Types of deflection tools, tool orientation, Directional well profiles, Well path deflection & correction.

Down Hole Motors: Positive displacement motors and Turbo-drills, motor description, Power calculation and applications - Auto-track and verti-track system - Rotary Steerable motors, Geo-steering tools.

Horizontal Well Drilling: Horizontal well objectives and selection, Different profiles, drilling techniques, Mud requirements & characteristics, casing and drill string requirements and completion programs. Problems.

Module 2 (12 Hours)

Slant Hole Drilling: Objectives and selections, Well profiles and applications.

Down the Hole Well Surveying: Well surveying objectives, surveying methods, Surveying Analysis methods and calculations for well coordinates.

Measurements While Drilling: Objectives of MWD/ LWD, MWD tools, Telemetry system and data interpretation.

Directional Drilling Problems and Their Remedies.

Special Methods of Drilling : Aerated drilling, Under-balanced drilling, Overbalanced drilling, HPHT Drilling, Variable pressure regime, Plasma drilling, Electrical Drilling, Top drive drilling, Re-entry drilling, Jet Drilling, Extended reach drilling, Multilateral drilling, Slim hole drilling, coil tubing drilling. Problems.

Drilling economics. Computer Application in Drilling.

DESIGN AND CONSTRUCTION OF PIPELINE

Module 3 (12 Hours)

Objective and scope of pipeline as a means of fluid transportation with special reference to crude oil/gas/refined products, Economics of Pipeline transportation.

Design of Pipeline: Factors influencing oil, gas and refined products as pipeline design; Hydraulic surge and water hammer; specific heat of liquids; river crossing; pipe size and station spacing etc.

Theory and different formulae of the flow of fluids in oil/gas pipelines; basic equations for the flow of fluids through pipes; different flow equations for laminar and turbulent flow of compressible and incompressible fluids (Newtonian); Introduction to the flow of Non-Newtonian fluids through pipes; multiphase flow and loop pipelines.

Module 4 (12 Hours)
Construction of pipelines; materials; project specifications; general equipment specifications (Pipes, valves and fittings); Installation of expansion loops and thermodymetric tapping plant. Pigging, Pigging Technology: pig launcher and receiver, intelligent pigging, types of pigs - Corrosion protection and control; Design of cathodic protection system, Pipeline automation. Problems.

Module 5 (12 Hours)
Offshore Pipeline: Design and control of Sag and Over bend; Description of stinger; and Riser, articulated stinger, construction of offshore pipeline, Method of underwater welding.
Hydrates, wax & scale - formation and prevention. Crude conditioning and use of additives to improve flow conditions. City distribution network of oil/gas. Lease and custody transfer.

References:

1. Berger B D, Anderson K E, “Modern Petroleum” Pennwell books
2. Bradley H B, “Petroleum Engineering Handbook”, SPE
3. Cole F W, Reservoir Engineering manual
4. Carl Gatlin, “Petroleum Engineering Drilling and Well Completions” Prentice Hall .
5. Mc Cray and Cole, “Oil Well Drilling Technology” Oklahoma Press

AU010 806

AUTOMOBILE WORKSHOP – III

Teaching scheme Credits: 2
3 hour practical per week

1. Study of various sensors used in automobiles
2. Study of electronic components and basic electronic circuits used in automobiles
3. Design and Construct a working model of starting circuit with components given
4. Design and Construct a working model of charging & horn circuits with components given
5. Design and Construct a working model of lighting circuit with components given
6. Design and Construct a working model of ignition system with components given
7. Demonstration of dash board panel instruments and controls
8. Interfacing seven segment displays.
9. Speed measurement using sensor
10. On-board diagnostics (OBD) of electronic fuel injection engines
11. Interfacing of stepper motor
12. Interfacing of dc motor
13. Interfacing various sensors like RTD, LVDT, load cell etc..
14. Interfacing of actuators.
15. Design and testing of the circuit for keyless entry
16. Design and testing of the circuits for ABS, Cruise Control.
17. Design and testing of the circuits for Power Steering , Parking System , power window
18. Interfacing ADC for data acquisition and DAC for control application.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Internal Practical examination at the end of semester
20% - viva
20% - Rough record & fair record
20% - Regularity in the class

University Examination Pattern *(Maximum Marks-100)*

20% - Initial Write Up (Aim, Tools Required, Materials Required, Theory, Procedure)
40% - Performance in Test
20% - Viva
10% - Result / Inference
10% - Rough record & Fair Record

AU010 807 Project Work

Teaching scheme **credits: 4**

6 hours practical per week

The progress in the project work is to be presented by the middle of eighth semester before the evaluation committee. By this time, the students will be in a position to publish a paper in international/ national journals/conferences. The EC can accept, accept with modification, and request a resubmission.

The progress of project work is found unsatisfactory by the EC during the middle of the eighth semester presentation, such students has to present again to the EC at the end of the semester and if it is also found unsatisfactory an extension of the project work can be given to the students.

Project report: To be prepared in proper format decided by the concerned department. The report shall record all aspects of the work, highlighting all the problems faced and the approach/method employed to solve such problems. Members of a project group shall prepare and submit **separate** reports. Report of each member shall give details of the work carried out by him/her, and only summarise other members' work.

The student's sessional marks for project will be out of 100, in which 60 marks will be based on day to day performance assessed by the guide. Balance 40 marks will be awarded based on the presentation of the project by the students before an evaluation committee.

For Project, the minimum for a pass shall be 50% of the total marks assigned to the Project work.

AU010 808 Viva -Voce

Teaching scheme **credits: 2**

A comprehensive oral Viva-voce examination will be conducted to assess the student's intellectual achievement, depth of understanding in the specified field of engineering and papers published / accepted for publication etc. At the time of viva-voce, certified bound reports of seminar and project work are to be presented for evaluation. The certified bound report(s) of educational tour/industrial training/ industrial visit shall also be brought during the final Viva-Voce.

An internal and external examiner is appointed by the University for the Conduct of viva voce University examination.

For Viva-voce, the minimum for a pass shall be 50% of the total marks assigned to the Viva-voce.

Note: If a candidate has passed all examinations of B.Tech. course (at the time of publication of results of eighth semester) except Viva-Voce in the eighth semester, a re-examination for the Viva-Voce should be conducted within one month after the publication of results. Each candidate should apply for this 'Save a Semester examination' within one week after the publication of eighth semester results.