# Rajasthan Technical University (RTU)

# AUTOMOBILE ENGINEERING

**YEAR II/ SEMESTER III THEORY**

| S. No. | Code No. | Subject | L | T | MM | Ex. Hrs. |
|---|---|---|---|---|---|---|
| **1.** | 3AE1 | Mechanics of solids | 3 | 1 | 100 | 3 |
| **2.** | 3AE2 | Material science & engineering | 2 | 0 | 100 | 3 |
| **3.** | 3AE3 | Engineering thermodynamics | 3 | 1 | 100 | 3 |
| **4.** | 3AE4 | Manufacturing processes | 3 | 0 | 100 | 3 |
| **5.** | 3AE5 | Object oriented programming in C++ | 3 | 0 | 100 | 3 |
| **6.** | 3AE6 | Advanced engineering mathematics | 2 | 1 | 100 | 3 |
| | | **Total** | **16** | **3** | **600** | **-** |

**PRACTICALS AND SESSIONALS**

| S. No. | Code No. | Subject | T/S | MM |
|---|---|---|---|---|
| **1.** | 3AE7 | Strength of Materials Lab | 2 | 50 |
| **2.** | 3AE8 | Material Science Lab | 2/2 | 50 |
| **3.** | 3AE9 | Thermal Engineering Lab I | 2 | 50 |
| **4.** | 3AE10 | Production Engineering Practice | 3 | 75 |
| **5** | 3AE11 | Computer Programming Lab | 2 | 50 |
| **6.** | 3AE12 | Machine Drawing | 3 | 75 |
| **7.** | 3AEDC | Discipline and Extra Curricular Activities | - | 50 |
| | | **Total** | **13** | **400** |
| | | **Grand Total** | | **1000** |

# Rajasthan Technical University (RTU)

# AUTOMOBILE ENGINEERING

**YEAR II/ SEMESTER IV THEORY**

| S. No. | Code No. | Subject | L | T | MM | Ex. Hrs. |
|---|---|---|---|---|---|---|
| **1.** | 4AE1 | Design of Machine Elements - I | 3 | 0 | 100 | 3 |
| **2.** | 4AE2 | Automotive Systems | 3 | 0 | 100 | 3 |
| **3.** | 4AE3 | Fluid Engineering | 3 | 1 | 100 | 3 |
| **4.** | 4AE4 | Machining & Machine Tools | 3 | 0 | 100 | 3 |
| **5.** | 4AE5 | I.C. Engines | 3 | 0 | 100 | 3 |
| **6.** | 4AE6 | Mechanical Measurement & Control | 3 | 0 | 100 | 3 |
| | | **Total** | **18** | **1** | **600** | **-** |

**PRACTICALS AND SESSIONALS**

| S. No. | Code No. | Subject | T/S | MM |
|---|---|---|---|---|
| **1.** | 4AE7 | Machine Design I | 2 | 50 |
| **2.** | 4AE8 | Fluid Mechanics Lab | 2 | 50 |
| **3.** | 4AE9 | Production Practice II | 3 | 75 |
| **4.** | 4AE10 | Automobile Engineering Lab | 2 | 75 |
| **5.** | 4AE11 | Measurement & Control Lab | 2 | 50 |
| **6.** | 4AE12 | Hum. & Social Sciences | 2 | 50 |
| **7.** | 4AEDC | Discipline and Extra Curricular Activities | - | 50 |
| | | **Total** | **13** | **400** |
| | | **Grand Total** | | **1000** |

# Rajasthan Technical University (RTU)

# AUTOMOBILE ENGINEERING

**YEAR III/ SEMESTER V THEORY**

| S. No. | Code No. | Subject | L | T | MM | Ex. Hrs. |
|---|---|---|---|---|---|---|
| **1.** | 5AE1 | Heat transfer in IC engine | 3 | 1 | 100 | 3 |
| **2.** | 5AE2 | Automotive electrical & electronics | 3 | 0 | 100 | 3 |
| **3.** | 5AE3 | Computer graphics & design | 3 | 1 | 100 | 3 |
| **4.** | 5AE4 | Advanced IC engine I | 3 | 1 | 100 | 3 |
| **5.** | 5AE5 | Automotive transmission | 3 | 0 | 100 | 3 |
| **6.** | 5AE6 | Theory of machines | 3 | 1 | 100 | 3 |
| | | **Total** | **18** | **4** | **600** | **-** |

**PRACTICALS AND SESSIONALS**

| S. No. | Code No. | Subject | T/S | MM |
|---|---|---|---|---|
| **1.** | 5AE7 | Thermal engg. lab II | 2 | 100 |
| **2.** | 5AE8 | Automotive electrical & electronics lab | 2 | 50 |
| **3.** | 5AE9 | Software and computer graphics lab | 2 | 100 |
| **4.** | 5AE10 | Dynamics of machine Lab | 2 | 100 |
| **5.** | 5AEDC | Discipline and Extra Curricular Activities | - | 50 |
| | | **Total** | **08** | **400** |
| | | **Grand Total** | | **1000** |

# Rajasthan Technical University (RTU)

# AUTOMOBILE ENGINEERING

**YEAR III/ SEMESTER VI THEORY**

| S. No. | Code No. | Subject | L | T | MM | Ex. Hrs. |
|---|---|---|---|---|---|---|
| **1.** | 6AE1 | Automotive chassis and auto system design | 3 | 1 | 100 | 3 |
| **2.** | 6AE2 | Automatic control engineering | 3 | 1 | 100 | 3 |
| **3.** | 6AE3 | Design of machine elements II | 3 | 0 | 100 | 3 |
| **4.** | 6AE4 | Vehicle dynamics | 3 | 1 | 100 | 3 |
| **5.** | 6AE5 | Automotive emission & pollution control | 3 | 0 | 100 | 3 |
| **6.** | 6AE6 | Automotive heating, ventilation & air conditioning | 3 | 1 | 100 | 3 |
| | | **Total** | **18** | **4** | **600** | **-** |

**PRACTICALS AND SESSIONALS**

| S. No. | Code No. | Subject | T/S | MM |
|---|---|---|---|---|
| **1.** | 6AE7 | Auto transmission lab | 2 | 100 |
| **2.** | 6AE8 | Vehicles dynamics lab | 2 | 75 |
| **3.** | 6AE9 | Automotive system and pollution lab | 2 | 100 |
| **4.** | 6AE10 | Machine design lab II | 2 | 75 |
| **5.** | 6AEDC | Discipline and Extra Curricular Activities | - | 50 |
| | | **Total** | **08** | **400** |
| | | **Grand Total** | | **1000** |

# Rajasthan Technical University (RTU)

# AUTOMOBILE ENGINEERING

**YEAR IV/ SEMESTER VII THEORY**

| S. No. | Code No. | Subject | L | T | MM | Ex. Hrs. |
|---|---|---|---|---|---|---|
| **1.** | 7AE1 | Advanced IC engine II | 3 | 1 | 100 | 3 |
| **2.** | 7AE2 | Product development | 3 | 0 | 100 | 3 |
| **3.** | 7AE3 | CAD/CAM | 3 | 0 | 100 | 3 |
| **4.** | 7AE4 | Microprocessor application in automobile | 3 | 1 | 100 | 3 |
| **5.** | 7AE5 | Vehicle aerodynamics and vehicle body engg. | 3 | 1 | 100 | 3 |
| **6.** | | Elective-I | 3 | 1 | 100 | 3 |
| | 7AE6.1 | Mechatronic | | | | |
| | 7AE6.2 | Fuel cell, electric & hybrid vehicle | | | | |
| | 7AE6.3 | Quality Control | | | | |
| | 7AE6.4 | Vehicle transport management | | | | |
| | | **Total** | **18** | **4** | **600** | **-** |

**PRACTICALS AND SESSIONALS**

| S. No. | Code No. | Subject | T/S | MM |
|---|---|---|---|---|
| **1.** | 7AE7 | IC engine lab | 2 | 75 |
| **2.** | 7AE8 | CAD/CAM lab | 2 | 75 |
| **3.** | 7AE9 | Body engineering lab | 2 | 50 |
| **4.** | 7AE10 | Practical training & industrial visit | 2 | 100 |
| **5.** | 7AE11 | Project-stage I | 2 | 50 |
| **6.** | 7AEDC | Discipline and Extra Curricular Activities | - | 50 |
| | | **Total** | **10** | **400** |
| | | **Grand Total** | | **1000** |

# Rajasthan Technical University (RTU)

# AUTOMOBILE ENGINEERING

**YEAR IV/ SEMESTER VIII THEORY**

| S. No. | Code No. | Subject | L | T | MM | Ex. Hrs. |
|---|---|---|---|---|---|---|
| **1.** | 8AE1 | Alternative fuels & IC engine tribology | 3 | 1 | 100 | 3 |
| **2.** | 8AE2 | Industrial robotics | 3 | 1 | 100 | 3 |
| **3.** | 8AE3 | Automotive maintenance & management | 3 | 1 | 100 | 3 |
| **4.** | 8AE4.1<br>8AE4.2<br>8AE4.3<br>8AE4.3 | Elective-II<br>Finite element method<br>Industrial engineering<br>Earth moving equipment<br>Vehicle vibration & noise control | 3 | 1 | 100 | 3 |
| | | **Total** | **12** | **4** | **400** | **-** |

**(B) PRACTICALS AND SESSIONALS**

| S. No. | Code No. | Subject | T/S | MM |
|---|---|---|---|---|
| **1.** | 8AE5 | Auto maintenance lab | 3 | 125 |
| **2.** | 8AE6 | Auto reconditioning lab | 3 | 125 |
| **3.** | 8AE7 | seminar | 2 | 100 |
| **4.** | 8AE8 | Project stage-II | 4 | 200 |
| **5.** | 8AEDC | Discipline and Extra Curricular Activities | - | 50 |
| | | **Total** | **12** | **600** |
| | | **Grand Total** | | **1000** |

**Syllabus for III Semester (II Year) B.Tech. (Automobile Engineering)**

## 3AE1: MECHANICS OF SOLIDS

**3L+1T** **MM: 100 Ex Hrs: 3**

**Unit 1**

**Stress & strain**:

Tension, compression, shearing stress & strain; Poisson's ratio: Stress-strain relationship, Hooke's law; equations of static = w for 2D & 3D cars Elastic constants and their relations for a isotropic hookean material, anisotropy & orthotropy, thermal stresses, composite bars; simple elastic, plastic & visco-elastic behavior of common materials in tension and compression test, stress-strain curves. Concept of factor of safety & permissible stress. Conditions for equilibrium. Concept of free body diagram; Introduction to mechanics of deformable bodies.

**Unit 2**

**Members subjected to flexural loads**:

Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams. Bending stresses, Section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc.

**Unit 3**

**Principal planes, stresses & strains**:

Members subjected to combined axial, bending & Torsional loads, maximum normal & shear stresses; Concept of equivalent bending & equivalent twisting moments: Mohr's circle of stress & strain.

Theories of Elastic Failures: The necessity for a theory, different theories, significance and comparison, applications.

**Unit 4**

**Torsion**: Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity.

Stability of equilibrium: Instability & elastic stability. Long & short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations.

**Unit 5**

**Transverse deflection of beams**:

Relation between deflection, bending moment, shear force and load, Transverse deflection of beams and shaft under static loading, area moment method, direct integration method: method of superposition and conjugate beam method. Variational approach to determine deflection and stresses in beam. Elastic strain energy: Strain energy due to axial, bending and Torsional loads; stresses due to suddenly applied loads; use of energy theorems to determine deflections of beams and twist of shafts. Castigliano's theorem. Maxwell's theorem of reciprocal deflections.

**List of Recommended Books**


1. Mechanics of Materials, James M.Gere, Cengage Learning (Brooks\Cole).
2. Mechanics of Material, Pytel & Kiusalaas, Thomson (Brooks\Cole).
3. An Introduction to the Mechanics of Solids; Crandall, Dahl & Lardner, Tata McGraw Hill.
4. Mechanics of Materials, Beer, Johnston, Dewolf and Mazurek, Tata McGraw Hill.
5. Strength of Materials, Ryder, G.H., Macmillan India.
6. Strength of Materials, Sadhu Singh, Khanna Publishers.
7. Mechanics of Material, Punmia, Jain and Jain, Laxmi Publication.


## 3AE2: MATERIAL SCIENCE AND ENGINEERING

**2L+0T** **MM: 100 Ex Hrs: 3**

**UNIT 1**

**Atomic structure of Metals:**

Crystal structure, crystal lattice of (i) Body centered cubic (ii) Face centered cubic (iii) Closed packed hexagonal, crystallographic Notation of atomic planes and Directions (Miller Indices), polymorphism and allotropy, Crystal imperfection.

**UNIT 2**

**Theories of plastic deformation:**

Phenomenon of slip, twinning and dislocation. Identification of crystallographic possible slip planes and direction in FCC, BCC, HCP. Recovery and recrystallization, preferred orientation causes and effects on the property of metals.

**UNIT3**

**Classification of engineering materials:**

Solidification of metals and of some typical alloys: Mechanism of crystallisation (I) nuclear formation (ii) crystal growth. General principles of phase transformation in alloys, phase rule and equilibrium diagrams, Equilibrium diagram of binary system having complete mutual solubility in liquid state and limited solubility in solid state, Binary isomorphous alloy system, Hume-Rothery rule, Binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with a peritectic transformation. Equilibrium diagram of a system whose components are subject to allotropic change. Iron carbon Equilibrium diagram, phase transformation in the iron carbon diagram (I) Formation of Austenite (ii) Transformation of Austenite into pearlite (iii) Martensite transformation in steel, TTT curves.

**UNIT 4**

**Engineering properties and their measurements:**

Principles and applications of annealing, normalising, hardening, tempering. Recovery and recrystallization. Hardenability -its measures, variables, effecting Hardenability, methods, for determination of Hardenability. Over-heated and Burnt steel, its causes and remedies. Temper brittleness -its causes and remedies. Basic principles involved in heat treatment of plain carbon steel, alloy steels, cast iron and Non-ferrous metals and their alloys. Chemical Heat treatment of steels: Physical principles involved in chemical heat treatment procedure for carburizing, Nitriding, Cyaniding, carbo-nitriding of steel.

**UNIT 5**

Effects produced by Alloying element on the structures and properties of steel Distribution of alloying elements (Si, Mn, Ni, Cr, Mo, Co, W, Ti, Al) in steel, structural classes of steel. Classification of steels, BIS Standards. Fibre reinforced plastic composites**:** Various fibres and matrix materials, basic composite manufacturing methods, applications of composite materials.

**List of Recommended Books**


1. An Introduction to Material Science & Engineering, William D.Callister, John Wiley & Sons.
2. Material Science, Raghvan V., Prentice Hall India.
3. Principles of Material Science & Engineering, William F.Smith, Tata McGraw-Hill Publications.
4. Engineering Physical Metallurgy, Lakhtin Y., Mir Publisher.
5. Heat Treatment – Principles and Techniques : Rajan T.V., Sharma C.P. and Sharma A. , Prentice Hall of India.
6. The Structure, Properties and Heat treatment of Metals, Davies D.J. and Oelmann L.A., Pitman Books , London.


## 3AE3: ENGINEERING THERMODYNAMICS

**3L+1T** **MM: 100 Ex Hrs: 3**

**UNIT 1**

**Basic Concepts of Thermodynamics** :

Thermodynamics system, control volume, Properties, state, processes and cycle, equality of temperature, Zeroth Law of thermodynamics, temperature scale, laws of perfect gas, Pure substances, vapour-Liquid –solid-phase equilibrium in a pure substances, thermodynamic surfaces

**UNIT 2**

**Work and heat,** Law of conservation of mass and energy, First law of thermodynamics, steady state Processes, Second law of thermodynamics, Heat engine, Carnot cycle, thermodynamic temperature scale, entropy, change of entropy for different processes, equivalence of Kelvin plank and clausius statements, clausius inequality.

**UNIT 3**

**Available and unavailable energy**, availability of a non flow and steady flow system, Helmbeltz and Gibb's functions, Thermodynamic Relations: Important mathematical relations, Maxwell relations, T-ds Relations, Joule-Thomson coefficient, Clayperon relation.

**UNIT 4**

**Air – standard power cycle,** Brayton cycle, Otto cycle, diesel cycle, Dual cycle, Stirling cycle, Ericssion cycle and Atkinson cycle, Mean effective pressure and efficiencies, Four stroke petrol and diesel engine, Two stroke Petrol and diesel engine.

**UNIT 5**

**Properties of steam,**

Phase change process, use of steam table & mollier char. Rankine cycle, Reheat cycle, Regenerative cycle, cogeneration vapour compression refrigeration cycle.

**List of Recommended Books**


1. Engineering Thermodynamics, Chottopadhyay P., Oxford University Press.
2. Thermal Science & Engineering, Kumar D.S., S.K.Kataria & Sons
3. Engineering Thermodynamics, Nag P.K., Tata McGraw-Hill, New Delhi
4. Fundamentals of Classical Thermodynamics, Gordan J Van Wylen, Willey Eastern Ltd.
5. Engineering Thermodynamics, Cengel & Boles, Tata McGraw-Hill, New Delhi.


## 3AE4: MANUFACUTRING PROCESSES

**3L+0T** **MM: 100 Ex Hrs: 3**

**UNIT 1**

Importance of manufacturing, economic and technological definition of manufacturing, survey of manufacturing processes.

**Foundry Technology:** Patterns practices: Types of patterns, allowances and material used for patterns, moulding materials, moulding sands, Moulding sands; properties and sand testing; grain fineness; moisture content, clay content and permeability test, core materials and core making, core print; core boxes, chaplets, gating system design. Moulding practices**:** Green, dry and loam sand moulding, pit and floor moulding; shell moulding; permanent moulding; carbon dioxide moulding.

**Casting practices:** Fundamental of metal casting, sand casting, Shell-Mould casting, mold casting (plaster and ceramic), investment casting, vacuum casting, Permanent mould casting, slush casting, pressure casting, die casting, centrifugal casting, continuous casting, squeeze casting, casting alloys, casting defects, design of casting, gating system design, and riser design. Melting furnaces-rotary, pit electric, tilting and cupola.

**UNIT 2**

**Metal Joining Processes:**

Principle of welding, soldering, brazing and adhesive bonding. Survey of welding and allied processes. Arc welding: power sources and consumables. Gas welding and cutting: Processes and equipments. Resistance welding: principle and equipments. Spot, projection and seam welding process. Atomic hydrogen, ultrasonic, plasma and laser beam welding, electron beam welding, and special welding processes

e.g. TIG, MIG, friction and explosive welding, welding of C.I. and Al, welding defects. Electrodes and Electrode Coatings

**UNIT 3**

**Forming and Shaping Processes:**

Metal working, elastic and plastic deformation, concept of strain hardening, hot and cold working, rolling, principle and operations, roll pass sequence, forging, forging operations, extrusion, wire and tube drawing processes. Forging: Method of forging, forging hammers and presses, principle of forging tool design, cold working processes-Shearing, drawing, squeezing, blanking, piercing, deep drawing, coining and embossing, metal working defects, cold heading, riveting, thread rolling bending and forming operation.

**UNIT 4**

**Powder Metallurgy:**

Powder manufacturing, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of P/M.

**Rapid Prototyping Operations:**

Introduction, subtractive processes, additive processes, Virtual Prototyping and applications

**UNIT 5**

**Plastic Technology:**

Introduction, Classification of Plastics, Ingredients of Moulding compounds, General Properties of Plastics, Plastic part manufacturing processes such as compression moulding, transfer moulding, injection moulding, extrusion moulding, blow moulding, calendaring, thermoforming, slush moulding, laminating

**List of Recommended Books**


1. Manufacturing Technology, Rao P.N., Tata McGraw-Hill, New Delhi.
2. Manufacturing Engineering & Technology, Kalpkajin, Addison Wesley Publishing Company.
3. Processes and Materials of Manufacture, Lindberg R. A., Prentice Hall of India.
4. Principles of Manufacturing Materials and Processes, Campbell J.S., Tata McGraw Hill.


## 3AE5: OBJECT ORIENTED PROGRAMMING IN C++

**3L+0T** **MM: 100 Ex Hrs: 3**

**UNIT 1**

**Introduction to Object Oriented Programming**: Basic concepts: Class, Object, Method, Message passing, Inheritance, Encapsulation, Abstraction, Polymorphism.

**UNIT 2**

**Basics of C++ Environment:** Variables; Operators; Functions; user defined, passing by reference, passing an array to the function, inline function, scope, overloading; Pointers: objects and lvalue, arrays and pointers, the new and delete operators, dynamic arrays, arrays of pointers and pointers to arrays, pointers to pointers and functions; Strings: String I/O, character functions in ctype.h, string functions in string.h.

**UNIT3**

**Object oriented concepts using C++:** Classes, Member functions, Friend functions, Constructors, Access functions, Private member functions, class destructor, static data and function members; Overloading: inline functions, this operator, overloading various types of operators, conversion operators; the String Class; Composition and Inheritance: Hierarchy and types of inheritance, protected class members, private versus protected access, virtual functions and polymorphism, virtual destructors, abstract base classes.

**UNIT 4**

**Templates and Iterators:**

Function and class templates, container classes, subclass templates, iterator classes; Libraries: standard C++ library, contents of a standard C headers, string streams, file processing: Files and streams classes, text files, binary files, classification of files, the standard template library.

**UNIT 5**

**Data Structures Using C++:**

Linked lists – Singly linked list, Doubly linked lists, Circular lists, Stacks and Queues priority Queues, Stacks, Queues.

**List of Recommended Books :**


1. Object Oriented Programming in C++, Robert Lafore, Pearson Education.
2. Programming with C++, John Hubbard Schaum's Outlines, Tata McGraw Hill.
3. Object Oriented Programming with C++, Balagurduswamy, Tata McGraw Hill
4. C++ Program Design, Cohoon & Davidson, Tata McGraw Hill.
5. C++ How to Program,Dietal & Dietel, Prentice Hall of India.
6. C++ Complete Reference, Herbert Schild, Tata McGraw Hill.
7. Let Us C++, Kanitkar Y., BPB Publisher.
8. Data Structures using C++; Tanenbaum, Prentice Hall International.
9. Data Structure through C++, Kanitkar Y., BPB Publisher.


## 3AE6: ADVANCED ENGINEERING MATHEMATICS

**2L+1T** **MM: 100 Ex Hrs: 3**

**Unit 1**

**Fourier Series and method of separation of variables (Boundary value problems):**

Expansion of simple functions in Fourier series, half range series, change of interval, Harmonic analysis. Application to the solution of wave equation and diffusion equation in one dimension and Laplace's equation in two dimensions by method of separation of variable

**Unit 2**

**Laplace Transform:**

Laplace Transform with its simple properties. Inverse Laplace transform convolution Theorem (without proof) solution of ordinary differential equation with constant coefficient .

**Unit 3**

**Special functions**:

Bessel's function of first kind, simple recurrence relations, orthogonal property.

Legendre's function of first kind simple recurrence relations, orthogonal property ,Rodrigue's formula.

**Unit 4**

**Numerical Analysis:**

Finite differences , Difference operators , forward, Backward, central & average operators.

Newton's forward and backward interpolation formula, Stirling's central difference formula

Lagrange's interpolation formula for unequal interval. Solution of non linear equations in one variable by Newton Raphson's and Regula falsi's method

.

**Unit 5**

**Numerical Analysis**:

Numerical solution of simultaneous algebraic equation by Gauss elimination and Gauss seidel method. Numerical differentiation , Numerical integration trapezoidal rule , Simpson's one third and three eight rule. Numerical solution of ordinary differential equation of first order: Picards method, Euler's and modified Euler's ,method, Milne's methods and Runga Kutta fourth order method.

**List of Recommended Books :**


1. Advanced Engineering Mathematics, Kreyszig, E., Wiley Eastern.
2. Advance Mathematics for Engineers, Chandrika Prasad, Prasad Mudranalaya, Allahabad.
3. Advanced Engineering Mathematics, Potter, Goldhers and Aboufadel, Wiley Eastern.
4. Numerical Methods for Scientist And Engineers, Jain,M.K., Jain R.K., Iyengar, S.R.K., Wiley Eastern
5. A First Course in Numerical Analysis, Ralston, A., Rabinowitz, P., McGraw Hill


## 3AE7: STRENGTH OF MATERIALS LAB

**2 Periods** **MM: 50**

1. Izod Impact testing.
2. Rockwell Hardness Testing.
3. Spring Testing
4. Column Testing for buckling
5. Torsion Testing
6. Tensile Testing
7. Compression Testing
8. Shear Testing
9. Brinell Hardness Testing
10. Bending Test on UTM.
11. Study of Fatigue Testing Machine.

## 3AE8: MATERIAL SCIENCE LAB

**2/2 Periods** **MM: 50**

1 Study of Engineering Materials and crystals structures. Study of models BCC, FCC, HCP and stacking sequence, tetrahedral and octahedral voids.

2 To calculate the effective number of atoms, co-ordination number, packing factors, c/a ratio for HCP structure.

3 Study of brittle and ductile fracture.

4 To prepare metallic samples for metallographic examination and to study the principle and construction of the Metallurgical Microscope.

5 Study of the following Micro structures: Hypo, Hyper and Eutectoid Steel, Grey, White, Nodular and Malleable Cast Iron.

6 Annealing of Steel -Effect of annealing temperatures and time on hardness.

7 Study of Microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron.
8 Hardening of steel, effect of quenching medium on hardness.
9 Effect of Carbon percentage on the hardness of Steel.
10 Study of various crystal structures and dislocations through models.
11 Study of Iron-Carbon Equilibrium Diagram and sketch the various structures present at room temperature.

### 3AE9: THERMAL ENGINEERING LAB 1

**2 Periods** **MM: 50**

1 Comparative study of four stroke diesel and petrol engines.
2 Comparative study of two stroke petrol and diesel engines.
3 Studies of fuel supply systems of diesel and petrol engines.
4 Study of cooling, lubrication and ignition system in diesel and petrol engines.
5 To study various types of Boilers and to study Boiler mounting and accessories.
6 To study various types of Dynamometers.
7 To study Multi Stage Air Compressors.
8 To find the BHP, Thermal efficiency of four stroke diesel engine.
9 Study of Brakes, Clutches, and Transmission System.
10 To prepare a comparison sheet of various automobiles (4 Wheeler and 2 Wheeler).

### 3AE10: PRODUCTION ENGINEERING PRACTICE

**3 Periods** **MM: 75**

Machine Shop

1. Study of lathe machine, lathe tools cutting speed, feed and depth of cut.
2. To perform step turning, knurling and chamfering on lathe machine as per drawing.
3. Taper turning by tailstock offset method as per drawing.
4. To cut metric thread as per drawing.
5. To perform square threading, drilling and taper turning by compound rest as per drawing.
6. To study shaper machine, its mechanism and calculate quick return ratio.

Foundry Shop

1. To prepare mould of a given pattern requiring core and to cast it in aluminium.
2. Moisture test and clay content test.
3. Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).
4. Permeability Test.
5. A.F.S. Sieve analysis Test.

### 3AE11: COMPUTER PROGRAMMING LAB

**2 Periods** **MM: 50**

**List of programs in C:**

1 Program for revising control statements, arrays and functions.
2 Program using string handling and various functions described in string.h, ctype.h.
3 Program using structures and sorting algorithm (Insertion, Selection, Quick, Heap sort) and functions described in math.h.
4 Program using file handling and related functions defined in stdio.h.
5 Program using pointers, array and pointers, pointers to structures, dynamic memory

allocation.

**List of Programs in C++**

1 Program using basic I/O and control statements.
2 Program using class, objects, objects as function parameters.
3 Program using functions and passing reference to a function, inline functions. Program using Inheritance and virtual base class.
4 Program using pointers, arrays, dynamic arrays. Program using functions defined in ctype.h and string.h.
5. Program using constructors, destructors. Program using function and operator over
6. Loading List of program in C++ implementing Data Structures.
7. Creating and managing (add, delete, print, insert) nodes of a Linked list.
8. Creating and managing (create, pop, push etc.) stacks and queues.

*Note: Students should submit and present a minor project at the end of the lab.*

## 3AE12: MACHINE DRAWING

**3 Periods** **MM: 75**

**Detail drawings:**

Couplings: Pin-type flexible coupling etc,
IC. Engine parts: connecting rod, crank shaft, etc.
Boiler Mountings: Steam stop valve/ feed check-valve/ safety valve /three way stop valve blow off- cock.
Bearings: Swivel bearing
Machine Tool Parts: Shaper tool head, Lathe Tail Stock, Turret Tool Post, Turret Bar feeding Mechanism / Universal Dividing Head, Swivel machine vice.
Miscellaneous: Screw jack and drill-press vice.
Free Hand Sketches: Pipes and Pipe fittings, clutches, bearings, bearing puller, valve gear mechanisms, machine arbor and cutter, universal dividing head, jigs and fixtures, Step less drive , sliding gear box.

**Syllabus for IV Semester (II Year) B.Tech. (Automobile Engineering)**

## 4AE1: DESIGN OF MACHINE ELEMENT-I

**3L+0T** **MM: 100**

**UNIT I**
**Materials:**
Prosperities and IS coding Of Various Material, selection of material from properties and economic aspect. Manufacturing aspect in design : selection of Manufacturing processes on the basis of design and economy, Influence rate of production, standard size ;Influence of limits , fits, tolerance and surface finish, change in the shape of the design element of facilitate its production, design of casting, working drawing.

**UNIT II**
**Design for Strength :**
Allowable stresses , Details discussion on factor of safety ( Factor Of Ignorance);Stress Concentration-Cause and mitigation.
Introduction of various design consideration like strength , stiffness, weight, cost space etc. Concept of fatigue failure, Design of machine element subjected to direct stress, Pin , Cotter and keyed joints.

**UNIT III**
**Design of Members in bending** :
Beam , leaver and laminated springs.

**UNIT IV**
**Design of members in torsion** :
Shafts and shaft coupling.

**UNIT V**
**Bracket under combined stressed**.
Calculation of transverse and torsional deflection. Design of screw fastening, Screw Fasteners subjected to eccentric loading.

**List of Recommended Books**


1. Mechanical Machine Design, Bahl & Goel, Standard Publishers Distributors.
2. Design of Machine Elements, Bhandari V.B, Tata McGraw-Hill, New Delhi.
3. Machine Design, Sharma & Aggarwal, S.K.Kataria & Sons, Delhi.
4. Mechanical Engg Design, Shigley, Mischke, Budynas & Nisbett, Tata McGraw-Hill.
5. Design of Machine Elements, Sharma & Purohit, Prentice Hall India.
6. Machine Design, Kulkarni S. G., Tata McGraw Hill
7. A Text Book of Machine Design, Karwa A., Laxmi Publication.
8. Machine Design, Hall, Holwenko & Laughlin, Schaum's Outlines Series, Tata McGraw Hill.

## 4AE2: AUTOMOTIVE SYSTEMS

**3L+0T** **MM:100**

**UNIT I**

**Clutch :**

Purpose, Type of clutch , One way clutch etc. Diaphragm clutch , Faults & remedies , Power clutch , dual clutch system . Selection criterion area of gear ratio, sliding mash.

**Gear Box :** Purpose constant mash & synchromesh gear boxes , Gear selection and selector and shifting mechanism. Layout of a 5 forward and 1 reverse gear box , G.B. Lubrication , Transfer Gear Box , Four Wheel drive.

**Propeller Shafts & Universal Joints :** Torque tube and Hotchkiss drive Hooks type. Universal joints , shaft whirling , C.V. Joints, Divided propeller shaft, rubber universal coupling, slip joints.

**UNIT II**

**Final Drive and Rear axle :**

Purpose of differential , Construction and working , non slip differential chain sprocket final drive , cone pulley. Live and Dead axle , Fully floating , semi floating & three quarter floating axle , uses.

**Wheels & Tyre :**

Type of wheels , Construction , wired wheels , tyre , construction types, Radial, bias &belted bias, comparison slip angle , under and over steering, thread pattern, tyre retreading cold & hot , tyre specification , tubeless tyre.

**UNIT III**

**Suspension :**

Purpose , front and rear suspension , Two and four wheel independent suspension, suspension system components , Leaf spring , coil springs , dampers , torsion, bar , Mac pherson strut , Stabilizer bars, Arms, etc. Air suspension systems , Types of front & rear suspension.

Steering System : Types of steering system , Ackermann principles, Davis steering gear, system components , steering gear boxes, rack and pinion steering gear, type of steering linkages , Power steering , wheel geometry, caster , camber, toe in , toe out etc. Wheel alignment and wheel balancing.

**UNIT IV**

**Brakes ;**

Types of Brakes , Mechanical hydraulic , Air brakes , Disc & drum brakes , self energizing brakes , Engine Brakes , Brake system components, Valve calipers , shoes.

**UNIT V**

**Hydraulic coupling & Automatic transmission coupling and converter,** Use system components, coupling fluid , cooling , speed ratio. Torque speed characteristics, Automatic Transmission. Fundamental of epicycle gear trains , Law of Gearing –law of Neutral , Overdrive , reduction etc. Study of special gear boxes.

**List of Recommended Books**


1. Power Transmission , Anil Chikara, Satya Publication.
2. Automotive Mechanics , William . H. Couse , McGraw-Hill Publication
3. Automobile Engineering , Kripal Singh, Standard Publication.
4. Automobile Engineering , K.M. Gupta , Umesh Publication

**4AE3: FLUID ENGINERING**

**3L+1T** **MM:100**

**UNIT I**

**Basic Concept relating to fluid :**

Definitions – Incompressible and compressible fluids. Density, relative density, viscosity, kinematics viscosity. Newtonian & Non Newtonian fluids , effect of temperature and pressure on viscosity. Ideal fluid , Compressibility and Elasticity of Fluid and surface tension.

**UNIT II**

**Static pressure and Its Measurements :**

PASCAL's Law , Manometer , Fluid Static ; Total Pressure, centre of pressure , problems on plane and curved surface , definition of buoyancy , centre of buoyancy. Metacentre and Metacentric height.

**Fluid Kinematics' :**

Definition , steady and unsteady flow law, uniform and non uniform flow, one , two and three dimensional flow , Rotational and Irrotatinal flow, Streamlines , Path line and streak line. Continuity equation in Cartesian and polar coordinates , Circulation and vorticty , Steam function and velocity potential, vortex flow.

**UNIT III**

**Fluid Dynamics :**

Euler's equation of motion – Bernoulli's equation , application of Bernoulli's equation-Venturi metere , Orifice Meter , pitot tube , orifice , mouthpiece and time of emptying tanks. Momentum equation-application of the momentum equation , Pipe bends curves vanes. Compressible Flow.

**UNIT IV**

**Flow through pipes :**

Reynolds experiments of critical velocities , Pipes in series and parallel.

Dimension Analysis : Buckingham – π theorem, Dimensionless numbers , Model similitude, types of model, scale effect and model testing.

**UNIT V**

**Hydraulic turbine :**

Euler's Fundamental equation. Classification of turbine . Pelton wheel, Francis turbine , Kaplan turbine , Velocity triangle , Power and efficiency calculation , draft tube and cavitations , specific speed.

**Centrifugal Pump :**

Classification of centrifugal pump , velocity diagram , specific speed . head., power and efficiency. Reciprocating pump : Indicator diagram , slip , effect of friction and acceleration , Theory of air vessels. Hydraulic accumulator, Intensifier , Hydraulic ram.

**List of Recommended Books**


**1.** Fluid Mechanics, Frank M. White, Tata McGraw-Hill Publications.
2. Fluid Mechanics, Cengel & Cimbala, Tata McGraw-Hill, New Delhi.
3. Hydraulics & Fluid Mechanics, Modi & Seth, Standard Book House.
4. Fluid Mechanics, Jain A.K., Khanna Publishers.
5. Introduction to Fluid Mechanics, Fox & McDonald, John Wiley & Sons.

## 4AE4 : MACHINING AND MACHINE TOOLS

**3L+0T** **MM: 100**

**UNIT 1**

**Classification of metal removal process and machines Mechanics of metal cutting:** Geometry of single point cutting tool and tool angles. Tool nomenclature in ASA, ORS, NRS and interrelationship. Mechanism of chip formation and types of chips, chip breakers. Orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting. Thermal aspects of machining and measurement of chip tool interface temperature. Friction in metal cutting.

**UNIT 2**

**Machinability:**

Concept and evaluation of machinability, tool life, mechanisms of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability. Cutting fluids: Types, properties, selection and application methods

General Purpose Machine Tools: Classification and constructional details of lathe, drilling, milling, shaping and planning machines. Tooling, attachments and operations performed, selection of cutting parameters, calculation of forces and time for machining. Broaching operation.

**UNIT 3**

**Special Purpose Machine Tools**:

Automatic lathes, capstan and turret lathe machines. Swiss automatic, operational planning and turret tool layout, sequence of operations. Tracer attachment in Machine Tools: mechanical-copying machines; Hydraulic Tracing Devices; Electric Tracing systems; Automatic tracing. Abrasive processes: Abrasives; natural and synthetic, manufacturing, nomenclature. Selection of grinding wheels, wheel mounting and dressing, characteristic terms used in grinding. Machines for surface and cylindrical grinding, their constructional details and processes. Surface finishing: Honing, lapping, superfinishing, polishing and buffing processes.

**UNIT 4**

**Thread Manufacturing:**

Casting; thread chasing; thread cutting on lathe; thread rolling, die threading and tapping; thread milling; thread grinding. Gear Manufacturing Processes: hot rolling; stamping; powder metallurgy; extruding etc. Gear generating processes: gear hobbling, gear shaping. Gear finishing processes: shaving, grinding, lapping, shot blasting, phosphate coating, Gear testing.

**UNIT 5**

**High Velocity Forming Methods:**

(High-energy rate forming processes) Definition; Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming. Industrial Safety: Human factor in machine equipment safety; reducing industrial noise; precautions to be taken by operators for safe working on different machine tools.

**List of Recommended Books**


1. Introduction to Machining Science, Lal G.K., New Age international Publishers.
2. Manufacturing Science, Ghosh & Malik, East West Press Private Limited.
3. Production Engineering Science, Pandey & Singh, Standard Publishers Distributer, Delhi.
4. All About Machine Tools, Karl H.Heller, Wiley Eastern Ltd., New Delhi

## 4AE5: I.C. ENGINES

**3L+0T** **MM:100**

**UNIT I**

**I.C. Engine** :

Classification , CI & SI Engines , Engine components Nomenclature , Bore , Stroke, Clearance volume. Displacement Volume , Compression ratio , IHP , BHP , Efficiencies- Mechanical , Thermal , Volumetric. Mean effective pressure , Specific Fuel consumption , Weight to power ratio, Specific Power, Specific weight etc. Engine Terminology , Inline . V type. Working : Four stroke & Two stroke engines , CI & SI engines , comparison of two strokes and four strikes engines , CI & SI engines , Valve timing diagram.

**UNIT II**

**Fuel System :**

S.I. engine fuel system – System components – Fuel tank , Fuel transfer pumps , simple carburetor , Modem carburetor , some important makes , calculation of A/F ratio , Aircraft carburetor, Fuel Injection , Injection parameters , system components.

C I engine fuel system – System parameter , Solid injection , Air Injection , CRDI , Unit injector, calibration TDCI.

**UNIT III**

**Ignition system :**

Requirements , system parameter , components circuit diagram Firing order, electronic ignition system Battery & magneto ignition system TAC, CDI, High Energy ignition system: need , types.

**UNIT IV**

**Cooling System :**

Need of Cooling schematic diagram of cooling system, Air cooling , water cooling, cooling of special parts like valves , head etc. properties of coolant.

**UNIT V**

**Lubrication System :**

Need of lubrication , Places of lubrication , Function of lubricating oils . Lubrication system , splash pressurized , petrol system , dry sump and wet sumps , properties of lubricating oils. additives , multi-grading of oil . Mineral and synthetic oil , components , pumps , pressure relief valve etc.

**List of Recommended Books**


1. I.C. Engine , Mathur and Sharma , Dhanpat Rai New Delhi.
2. I.C. Engine , V Ganeshan , Tata McGraw-Hill Publication.
3. I.C. Engine , Domkundwar, Dhanpat Rai Publication.
4. I.C. Engine, . Gupta K.M, Umesh publication

## 4AE6 : MECHANICAL MEASURMENTS & CONTROL

**3L+0T** **MM : 100**

**UNIT 1**
System configuration, basic characteristic, calibration, classification and performance characteristics of a instrumentation system, Specification and testing of dynamic response. Strain Measurement : Electric Strain Gauges -Types ; Selection and Installation, Strain gauge circuits; temperature compensation and calibration; Use of Strain Gauges on Rotating Shafts, Load Cells, Mechanical and Optical Strain Gauges.

**UNIT 2**
Various Mechanical, Electro-Mechanical & Photoelectrical Sensors for sensing of Displacement, Velocity, Acceleration, Torque, Force, Temperature from Low to High Range, flow, level of fluid , pressure, angular speed, voltage, frequency and current.

**UNIT 3**
Introduction to Multi-Channel Data-Acquisition System, Measurement Pods, Interface Hardware, Data Analysis Software, Interfacing. Concepts and examples of automatic control systems, systems by differential equations, transfer function, block diagram, open and feed back control systems, signal flow graphs & its constructions. Control System components, error sensing devices and servo motors.

**UNIT 4**
Control for mechanical systems & processes ; speed control system for steam/gas turbines. A constant tension ;reeling system, Electro-mechanical systems. Thermal systems, Pneumatic systems; Mathematical Models of physical systems, Feed back characteristics of Control Systems. Time response analysis; transient response analysis, time response specifications, steady state-error.

**UNIT 5**
Concepts of stability, Routh-Hurwiz stability criterion, relative stability. The root locus technique, use of construction rules without any derivation. Frequency response analysis, Polar plots; stability in frequency domain, Bode / Logrithmic plots. Nyquist stability criterion.

**List of Recommended Books**


1. Mechanical Measurement, Beckwith, Pearson Education.
2. Experimental Methods for Engineers, Holman,Tata McGraw Hill Publication.
3. Mechanical Engineering Measurement, Sahwney A.R., Dhanpat Rai & Sons.
4. Modern Control Engineering, Ogata, Pearson Education India.
5. Control System, Gopal M., Tata McGraw Hill New Delhi.
6. Mechanical Measurement and Instrumentation, Rajput R.K., S.K.Kataria & Sons.

## 4AE7: MACHINE DESIGN I

**2Periods** **MM:50**

1. Selection mf material IS Coding
2. Selecting fit and assigning tolerances
3. Problems on
   (a) Knuckle and Cotter joints
   (b) Torsion : Shaft, Key and shaft couplings
   (c) Bending : Beams, Lever etc
   (d) Combined stresses : Shafts, Brackets, Eccentric loaded bolts etc.

## 4AE8 : FLUID MECHANICS LAB

**2 Periods** **MM: 50**

1. Find the metacentric height of a given body;.
2. Find the coefficient of discharge, coefficient of velocity and coefficient of contraction, of given orifice.
3. Determine the coefficient of discharge of V-Notch
4. Determine the flow rate of water by V-notch for given value of coefficient of discharge.
5. Find the velocity of fluid by Pitot tube.
6. Find the flow rate of fluid by Venturimeter.
7. Find the efficiency of Hydraulic ram.
8. Find the head loss in pipe for given length.
9. Fin d the flow rate by orifice meter.
10. Find the Reynolds number experimentally of laminar, transient and turbulent flow.

## 4AE9 : PRODUCTION PRACTICE II

**3 Periods** **MM:75**

**Machine Shop**

1. To study single point cutting tool geometry and to grind the tool to the given tool geometry.
2. To study milling machine, milling cutters, indexing methods and various indexing heads.
3. To prepare a gear on milling machine as per drawing.
4. Prepare a hexagonal / octagonal nut using indexing head on milling machine and to cut BSW . Metric internal threads on lathe.
5. To cut multi-start square / metric threads.
6. To cut external metric threads and to match it with the nut.
7. To prepare the job by eccentric turning on lathe machine.
8. To prepare a job on shaper from given MS rod.

**Welding shop**

Study of the effect of process parameters in welding

1. TIG Welding
2. MIG Welding

## 4AE10 : AUTOMOBILE ENGINEERING LAB

**2 Periods** **MM : 75**

1. Disassembling and assembling of multi-cylinder petrol and diesel engines and study of their parts.
2. To disassemble and assemble a 2-stroke petrol engine.
3. To disassemble and assemble a 4-stroke motor cycle engine and study of various engine parts.
4. Load test on a single cylinder 4-stroke diesel engine using a rope brake dynamometer and calculate volumetric and thermal efficiency and draw a heat balance-sheet.
5. Study of carburetors and MPFI system and disassembling and assembling of their parts.
6. To calculate valve timing of a multi-cylinder petrol engine and valve tappets adjustment.
7. Disassemble all the parts of a fuel injection pump and its parts study.
8. To disassemble the governor and study its various parts.

## 4AE11 : MEASURMENTS & CONTROL LAB.

**2 Periods** **MM : 50**

### MEASURMENT LAB

1. Displacement Measurement using Capacitive Pick -up System
2. Displacement Measurement Using Inductive Pick-up System
.3. Displacement Measurement Using Light Dependent Register Set up
   .(i) Displacement v/s Resistance at Constant Voltage
   .(ii) Voltage v/s Resistance at Constant Displacement
.4. Study of Speed Measurement System
   .(i) Magnetic Pick-up
   .(ii) Strobometer
5. Study of Load Measurement System Load Cell + Load Indicator
6. Calibration of Thermocouple Wire.

### CONTROL LAB.

1. Problems on
2. Block diagram reduction technique
3. Block diagram formation for Control Systems.
4. Root Locus Plot
5. Bode Plot
6. Polar plot & Nyquist Stability Criterion

**Experiments on**

1. Hydraulic System
2 Control System

## 4AE12: HUMANITIES AND SOCIAL SCIENCES

**2 Periods** **MM : 50**

**PART I**

1. From of government – Democracy , Dictatorship.
2. India:

(a) Brief history of Indian Constitution
(b) History of Indian National Movement
(c) After independence – Social – Economics growth.

3. Society :

(a) Social group – Concept & types
(b) Socialization – Concept , types & theory.
(c) Social Control – Concept, types & means
(d) Social problem – concept & types
4. Psycho analysis – theory of Mead and Sigmond, Freude.

**Part – II**

1. The Fundamentals of Economics – The logic of economics, fundamental problems definitions of economics, basic terminology.
2. Micro Economics
   Consumer's behavior – Utility, Demand, Supply, Elasticity of demand and supply, indifference curves.
3. Micro – Economics
   National Income, Business Cycles, Aggregate terms, Money and banking, Inflation, Economic Growth International Trade, exchange rates.

**Syllabus for V Semester (III Year) B.Tech. (Automobile Engineering)**

## 5AE1 : HEAT TRANSFER IN IC ENGINE

**3L+1T** **MM: 100**

**Unit 1**

**Introduction of heat transfer:**

Temperature, heat and thermal equilibrium, basic definition and law of heat transfer modes of heat transfer, steady and unsteady heat transfer, and significance of heat transfer.

**Conduction Heat Transfer**:

Fourier equation, general heat conduction equation: Cartesian co-ordinate, cylinder co-ordinate, spherical co-ordination, conduction through plane wall, composite wall, cylindrical, multi cylindrical wall, spheres. Critical thickness of insulation ,heat transfer from extended surface , steady state flow of heat along a rod, governing differential equations and their solution, heat dissipation from infinite long fin, insulated tip, fin performance.

**Unit 2**

**Convection**:

Stroke energy equation, hydrodynamic and thermal boundary layers:laminar boundary layer equation; forced convection appropriate non dimensional members, flow over flat plate, similarity solution. Von-karman's method, effect of Prandtl number. Laminar flow through circular pipe.

**Natural Convection**:

Dimensional analysis Grashoff number, boundary layers in external flow (flow over a flat plate only), boundary layer equations and their solutions. Heat transfer Correlation.

**Unit 3.**

**Radiation:**

Salient features and characteristics of radiations, absorptive, reflectivity and transmissivity, spectral and spatial energy distribution, wavelength distribution of black body radiation, Planck's law. Total emission power. Stefan Boltzman law, Wien's displacement law, Kirchoff's law , intensity of radiation & Lambert's consine law.

**Unit 4**

**Heat transfer in IC engine:**

Water and air cooling of engines, combustion systems and variation of gas temperatures, heat transfer coefficients, calculations of heat rejection to coolant. Heat transfer, temperature distribution and thermal stress in piston, piston ring, cylinder liner. Heat transfer through cylinder head, fins and valves, Effect of various operating parameter on engine heat transfer.

**Unit 5.**

**Heat exchangers used in IC engine :**

Principles of different type of Heat exchanger. Type of radiators , inter cooler and after cooler . EGR cooling and EGR coolers. Engine coolant and their properties.

**List of Recommended Books**

1. Heat Transfer By, Holman J.P., Tata McGraw-Hill publication.
2. Heat transfer By, Kumar D.S. , S.K. Kataria.
3. Heat Transfer By, Rajput R. K., S chand Publishing House New Delhi.
4. Heat Transfer By Sehgal , Tata McGraw-Hill publication New Delhi.

## 5AE2 AUTOMOTIVE ELECTRICAL AND ELECTRONICS

**3L** **MM:100**

**Unit 1**

**Storage Batteries**:

Principles, construction and operation of lead acid battery, battery capacity, efficiency, rating and performance. Determination of battery size. Electrolyte, Battery tests, Battery charging equipment and methods. Battery faults.

**Unit 2**

**Starter and charging system:**

Starting system requirements, sizing of starter motor and selection, characteristics of starter motor, type of starting, motor drive mechanisms, starter switch, starter system fault. DC Generator & AC alternators. Magneto. Armature reaction, cut out relay, voltage and current regulator system for generator and alternators.

**Unit 3**

**Auxiliary systems:**

Types of lamps used in automobile, head light, tail light, fog lights, brake light, side indicator, parking and other indicating lights. Principle of automotive illumination, dash board lights, indicators and meters, speedometers, electric horn, windshield wiper, heaters & defrosters, electric horn and relay devices, Different types of gauges and indicators. Electrical fuel pump.

**Unit 4**

**Ignition system:**

Working of coil ignition system and its components, spark advance mechanisms, limitations of coil ignition systems. Advantages of electronic ignition systems, types of solid state ignition systems and their principle of operation. Contact less electronic ignition system, electronic spark timing ands its control.

**Unit 5**

**Automotive sensors:**

Description and working of different engine and vehicle sensors such as speed sensor, tyre pressure sensor, oxygen sensors, fuel level sensor etc.

**List of Recommended Books**


1. Automotive Electrical and Electrinics By, Kohli P.L., Tata McGraw-Hill Publication.
2. Automobile Engineering By Kripal Singh , Standard Publication.
3. Automobile Engineering By, Gupta K.M, Umesh publication.
4. Automotive Mechanics By William H. Crouse, Tata McGraw-Hill publication

## 5AE3 : COMPUTER GRAPHICS & DESIGN

**3L+1T** **MM:100**

**UNIT 1**

**Computer hardware and software :**

Introduction – An overview of CAD – computer fundamentals – classification of computers – Data communication – configuration of computer system for design – Design work stations – Interactive display device – Input device – Output device – Computer software.

**Unit –2**

**Computer Drafting :**

Graphical input techniques - Transformation in graphics – Drafting through high level languages – Fundamentals of 2D drafting – 3D drawings.

**Unit –3**

**Modeling of Curve, Surface and Solid:**

Introduction – 3D geometry – Surface types – Conventions – attributes – Geometry – Example of surface modeling – Solid modeling.

**UNIT 4**

**Graphic standards:**

Introduction – Standards for graphics programming – Graphic standards – Product data exchange specification – Other data exchange formats.

**UNIT 5**

**Interfacing Drafting and Design Analysis:**

introduction – Parametric design – Script file – Application of a drawing exchange file – A design and drafting example – Operation in batch mode

**List of Recommended Books**


1. Computer Graphics, Radhakrishanan, Dhanpat Rai Publication New Delhi.
2. Computer Graphics, Baken , Tata McGraw-Hill Publication.
3. CAD/CAM, Ibrahim Zied, Tata McGraw-Hill Publication.
4. CAD/CAM, Groover , Tata McGraw-Hill Publication.

## 5AE 4 : ADVANCED IC ENGINE – I

**3L+1T** **MM:100**

**UNIT 1**

**Fundamentals:**

Cycle Analysis: Operating cycles of S.I. and C.I. engines and Gas turbines-Comparison of Air standard cycle-Fuel air cycle and actual cycles. Combustion of Fuels: Combustion stoichiometry of petrol, diesel, alcohol and hydrogen fuels-Chemical energy and heating values-Chemical equilibrium ad maximum temperature. Combustion in premixed and diffusion flames-Combustion process in IC engines.

**UNIT 2**

**SI Engine Combustion:**

Mixture preparation, Flammability limits of various fuels, Ignition, cool flames, Flame speed and area of flame front, stages of combustion, ignition delay, flame propagation, flame quenching. Cycle-to-cycle variations. Abnormal combustion-knocking, surface ignition, knock control, knocks sensing. Effect of various design and operating variables on gasoline combustion. Study of different combustion chamber designs. Air motion-turbulence, swirl squish and tumble. Multipoint fuel injection in gasoline engines.

**UNIT 3**

**CI Engine Combustion:**

Mixture preparation-fuel sprays characteristics-droplet size, penetration and atomization. Droplet and spray combustion theory-stages of combustion delay period-peak pressure-Heat release-Gas temperature-Diesel knock, combustion chamber design. Effect of different design and operating variable on CI combustion. Cold
starting.

**UNIT 4**

**Supercharging & Turbo charging:**

Objective, superchargers, supercharging principles for SI and CI engines, turbochargers and turbo charging methods, arrangement of exhaust manifold for turbocharged engines, charge cooling methods, Effect of turbo charging on engine performance. Trends in downsizing of engines.

**UNIT 5**

**Performance Testing of Engines:**

Basic engine testing, Methods of measurement of BHP, torque and speed, various types of engine dynamometers, engine performance parameters and performance maps, indicating diagram and measurement of IHP. Engine friction, various methods of measuring steady state and transient engine friction. Determination of thermal, mechanical and volumetric efficiencies of an engine. Engine heat balance.

**List of Recommended Books**


1. I.C. Engine , Mathur and Sharma , Dhanpat Rai New Delhi.
2. I.C. Engine , V Ganeshan , Tata McGraw-Hill Publication.
3. I.C. Engine , Domkundwar, Dhanpat Rai Publication.
4. I.C. Engine, Gupta K.M, Umesh publication.

## 5AE5 : AUTOMOTIVE TRANSMISSION

**3L** **MM:100**

**UNIT 1**

**Transmission requirements:**

Requirements of transmission system, general arrangements for power transmission for front engine, rear engine vehicle, four wheel drive vehicle, dead axle and axle less transmission.

**Clutch:** Single plate, multi plate clutch, centrifugal clutch, electromagnetic clutch, constructional details, torque capacity and clutch friction materials.

**UNIT 2**

**Gear box:**

Requirements of gear box, sliding mesh gear box, constant mesh gear box, synchromesh gear box, epicyclic gear box, velocity ratio and gear ratio for vehicle, performance characteristics in different speed , overdrive.

**UNIT 3**

**Hydrodynamic drive:**

**Fluid Coupling** : Principle of operation, constructional details, torque capacity and performance curve.

**Torque converter** :

Principle of operation, constructional details, torque capacity and performance curve. Multistage torque converter, converter fluid.

**UNIT 4**

**Hydrostatic drive:**

Various types of hydrostatic system, working principle of hydrostatic system, advantage and limitations, Jenny hydrostatic drive, comparison of hydrostatic and hydrodynamic drive.

**Electric drive:**

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

**UNIT 5**

**Automatic Transmission:**

Need for automatic Transmission, Chevrolet turbo glide transmission system, torque flite, Automatic transmission fluid, effect of automatic transmission on vehicle performance and fuel economy.

**List of Recommended Books**


1. Power Transmission, Anil Chikara, Satya Publication.
2. Automotive Mechanics, William . H. Couse , Tata McGraw-Hill Publication
3. Automobile Engineering, Kripal Singh, Standard Publication.
4. Automobile Engineering,Gupta K.M , Umesh Publication

## 5AE6 : THEORY OF MACHINE

**3L+1T** **MM:100**

**Unit 1**

**Kinematics:**
Element. pairs, mechanisms, four bar chain and its inversions, velocity and acceleration, Klein construction, corolis component, Instantaneous centre method, synthesis of mechanism, panto graph, Scott-Russel, Tchbeicheff straight line, indicator diagram mechanisms.

**Unit 2**
**Brakes:**
Band, Block and band & block brakes, braking action, braking system of automobiles.
**Dynamometers:**
Absorption and transmission type dynamometers, prony, rope and hydraulic dynamometers

**Unit 3**
**Cams:**
Types of cams, displacement, velocity and acceleration curves for different cam flowers, consideration of pressure angle and wear, analysis of motion of followers for cams with specified contours.
**Gyroscope :**:
Principle of gyroscope couple, effect of gyroscopic couple and centrifugal force on vehicle taking a turn, stabilization of sea vessels.

**Unit 4**
**Inertia force analysis**:
Velocity and acceleration of slider crank and four bar mechanism, inertia force, piston thrust and forces on connecting rod, Turning moment diagram and
Flywheel

**Unit 5**
**Gears:**
Law of gearing, terminology, tooth form, standard interchangeable tooth profile, minimum number of teeth on pinion in contact with gear or rack, interference and undercutting, helical and spiral gears.
**Gear trains**:
Simple, compound, reverted and epicyclic gear trains, analytical, tabular, graphical and vector methods for velocity ratio.

**List of Recommended Books**


1. Theory of Machines; Rattan S.S., Tata McGraw Hill.
2. Theory of Machines; Thomas Bevan, Pearson Education.
3. Theory of Machines & Mechanisms ; Uicker, Pennocle & Shigley, Oxford University Press.
4. Mechanism And Machine Theory, Ambekar A. G., Prentice-hall Of India.
5. Theory of Mechanisms and Machines, Sharma & Purohit, Prentice-hall Of India.
6. Theory of Mechanisms & Machines ; A.Ghosh, Affiliated East West Press.
7. Theory of Machines, Abdulla Shariff, Dhanpat Rai Publication.

## 5AE7 : THERMAL ENGINEERING LAB - II

**2P** **MM:100**

1. For Given apparatus determine :
   a. Thermal conductivity of given insulating powder.
   b. Critical thickness of insulation.
   c. Thermal resistant of insulating powder five parts.
   d. To plot theoretical temperature profile by dividing the thickness in mm.
   e. State all assumption applied in above calculation.

2. To find emmisivity of a grey body relative to a given black body and to find out the Stefan Boltzman constant.

3. To perform the experiments on pin fin test rig in forced convection by neglecting radiation losses and to calculate:
   a. Convective heat transfer coefficient. (Experimentally & using empirical correlation).
   b. Efficiency, Effectiveness.
   c. Comparison of experimental & theoretical temperature profile.
   d. Heat the same exercise by considering radiation losses.

4. To find the connective heat transfer coefficient of a given cylinder in vertical position by neglecting radiation losses by assuring.
   a. Constant surface temperature.
   b. Constant heat flux & compare with experimental heat transfer coefficient by neglecting radiation losses & by considering radiation losses.

5. Perform the experiment No. 4 by using cylinder in horizontal position.

6. To find the overall heat transfer coefficient of parallel flow / Counter flow Heat Exchanger.

7. To determine the efficiency and effectiveness of an automobile radiator.

## 5AE8 : AUTOMOTIVE ELECTRICALS AND ELECTRONICS LAB

**2P** **MM: 50**

1. Study of different type of Battery construction and different battery test.
2. Study of different automotive electrical system (Starting system, Ignition system, lighting system, wiring harness.)
3. Assembling and dismantling of Starter motor used in automobile.
4. Assembling and dismantling of alternator used in automobile.
5. Trouble shooting with Ignition system.
6. Study of different color code system used in automotive wiring system.
7. Study of different Electrical Equipments & Accessories ( Speedometer, Warning lights , Electric Horn , Wind shield wipers system )
8. Study of different sensor used in modern automotive system.
9. Study of various electronics system ( Electronic fuel injection system, Electronic ignition system , Air bag , ABS , Electronic fuel injector cleaner).

## 5AE9 : SOFTWARE AND COMPUTER GRAPHICS LAB

**2P** **MM:100**

1. Exercises using Auto LISP
2. Components drawing, assembly drawing and 3-D modeling on AutoCAD. Solid Modeling using Autocad, ANSYS/NISA/ Pro-engineer/CATIA/ IDEAS or equivalent software.
3. Four assignments on 3-D wire frame/surface/solid modeling using any advanced modeling software such as ADAMS CAR & Packages mentioned above containing solid models of complicated machine parts and simple 3D assembly containing 5 or more parts Programming on Graphics using Visual C++ and Open GL.

## 5AE10 : DYNAMICS OF MACHINE LAB

**2P** **MM:100**

1. To verify the relation T= I. ω. ωp for gyroscope.
2. To plot force v/s radius and lift v/s speed curves for governors.
3. To plot pressure distribution curves on a journal bearing.
4. To perform wheel balancing and wheel alignment test.
5. To perform static and dynamic balancing on balancing setup.
6. To determine mass moment of inertia of a fly wheel.
7. Study of a lathe gear box.
8. Study of a sliding mesh automobile gear box.
9. Study of planetary gear box.
10. Study of single suspension Test , seat Dynamic Test.
11. Study of ride comfort test system , noise measurement system.
12. Study of damping material effectiveness measurement system , Various Hydraulic and electromechanical actuator.

**Syllabus for VI Semester (III Year) B.Tech. (Automobile Engineering)**

## 6AE1: AUTO CHASSIS AND AUTO SYSTEM DESIGN

**3L+1T** **MM:10**

**UNIT 1**
**Introduction of Auto System Design**:
Aspects of Auto Design, Design Procedure, Principle of Design, Classification of design, Basic requirements of design, Quality of Design Engineer. Automotive chassis and chassis frame: general considerations related to chassis layout, power plant location, weight distribution, stability, types of frame, materials, calculation of stresses on sections construction details, loading points, testing of frames in bending and torsion.

**UNIT 2**
**Design of IC Engine Parts:**
General considerations of Engine Design, Principle of Similitude, and Design of Engine Components like: Piston, Cylinder, Connecting rod, Crank shaft, Valves.

**UNIT 3**
**Design of Clutch:**
Types of friction clutches, requirements of clutches, general design consideration, design the equation for power transmitted through single plate and multi plate clutch for Uniform wear and uniform pressure, design for dimensions of clutch, equation for centrifugal clutch.

**Unit 4**
**Design of Brake:**
General design considerations, braking efficiency, braking torque on the shoe, effect of expanding mechanism of shoes on braking torque, braking of vehicle for two wheel drive and four wheel drive, braking of vehicle for curved path calculation of mean lining pressure and heat generation during brake operation.

**Unit 5**
**Design of Suspension System**:
Function suspension system in automobile, design of helical coil spring, leaf spring, materials for spring, standard sizes of automobile suspension spring. Propeller Shaft: Design of Propeller shaft, Design of universal Joint.

**List of Recommended Books**

1. Auto Design, Gupta R.B., Satya Publication.
2. Element of Design ,Bhandari V.B., Tata McGraw-Hill publication
3. Machine Design, Khurmi R.S.., S Chand Publication , New Delhi.
4. Machine Design, Sharma and Agrawal, S.K. Kataria.

## 6AE2 : AUTOMATIC CONTROL ENGINEERING

**3L+1T** **MM:100**

**UNIT 1**
**Introduction:**
Concepts of automatic controls, open and closed loop systems, concept of feedback control. Requirements of an ideal control system. Differential equations for mechanical systems, transnational and rotational systems, Electrical systems such as servos, D.C. motors, A.C. Servomotors, Hydraulic systems, hydraulic servos meters, thermal systems, integrating devices, temperature control systems, error detection.

**UNIT 2**
**Systems Response:**
First and second order system response to step, ramp and sinusoidal inputs. Concept of time constant and its importance in speed response. Response of a system to an external disturbance. Mathematical concept of stability. Routh's Hurwitz criterion.

**UNIT 3**
**Block diagrams:**
Signal Flow Graphs and Transfer Function: Definition of transfer function, block representation of system elements. Reduction of block diagrams and signal flow paths, Basic properties, signal flow graphs, gain formula to block diagrams.

**UNIT 4**
**Frequency Response:**
Polar and rectangular plots for frequency response. Experimental determination of frequency response. System analysis using Nyquist diagrams, relative stability, concept of margin gain and phase margin. M & N cycles.

**UNIT 5**
**Systems Analysis:**
Systems Analysis using logarithmic Plots: Bode attenuation diagrams, Stability analysis using Bode diagrams, Simplifies Bode diagrams; Systems Analysis using Root Locus Plots: Definitions of root locus plots and root loci. Graphical relationship, setting systems gain. System Compensation

**List of Recommended Books**

1. Control System Engineering , Nagrath & Gopal , 4th Edition New age.
2. Modern Control Engineering ,. Ogata K, PHI Publication.
3. Automatic Control System, Kuo B.C., Willey India.
4. Modern Control Engineering , D.Roy Chaudhary, PHI Publication

## 6AE3 : DESIGN OF MACHINE ELEMENTS II

**3L** **MM:100**

**Unit 1**

**Fatigue Considerations in Design**:

Variable load, loading pattern, Endurance stresses, influence of size, surface finite, notch sensitivity & stress concentration, Goodman line, Soderberg, Design of machine members subjected to combined, steady and alternating stresses. Design of finite life. Design of shafts under Variable Stresses. Design of Springs: Helical compression, torsional and leaf springs. Springs under Variable Stresses.

**Unit 2**

**Design of Bolts:**

Preloading of bolts; effects of initial tension and applied load bolts subject to variable stresses. Design of weldments: welds subjected to eccentric loading and combined stresses. Design of curved members: Crane hook, body of C-clamp, machine frame etc

**Unit 3**

Design of flywheels Design of belt, rope and pulley drive system, chain & sprocket drive systems.

**Unit 4**

**Design of Gear**:

Lewis and Buckkhingam equations; wear and Dynamic load considerations, design and force analysis of spur, helical, bevel and worm analysis of spur, helical, bevel and worm gears. Bearing reactions due to gear tooth forces,

**Unit 5**

**Design of sliding & journal bearing:**

Method of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium. Selection of anti-friction bearings for different loads and load cycle Mounting of the bearings. Methods of lubrication, selection of oil seals.

**List of Recommended Books**


1. Mechanical Machine Design, Bahl & Goel, Standard Publishers Distributors .
2. Design of Machine Elements, Bhandari V.B, Tata McGraw-Hill, New Delhi.
3. Machine Design, Sharma & Aggarwal, S.K.Kataria & Sons, Delhi.
4. Mechanical Engg Design, Shigley, Mischke, Budynas & Nisbett, Tata McGraw-Hill.
5. Machine Design, Kulkarni S. G., Tata McGraw Hill.
6. PSG Design Data Book, P.S.G. College of Technology, Coimbatore.
7. A Text Book of Machine Design, Karwa A., Laxmi Publication.
8. Machine Design, Hall, Holwenko & Laughlin, Schaum's Outlines Series, Tata McGraw Hill.

## 6AE4 : VEHICLE DYNAMICS

**3L+1T** **MM:100**

**UNIT 1**

**Introduction**;

Vehicle Dynamics Definitions as prescribed by SAE, Newtonian and lagrangian formulations of multibody systems. Handling and stability characteristics: Steering geometry, fundamental equations for true rolling, Ackerman steering gear. Steady state handling neutral steer, under steer and over steer, steady state response, yaw velocity, lateral acceleration, curvature response, directional stability.

**UNIT 2**

**Performance characteristics of road vehicle**;

Various forces opposing vehicle motion, their nature and factors affecting these forces. Tractive effort and power available from the engine, equation of motion, maximum tractive effort and weight distribution, stability of vehicle on slop, road performance curves, acceleration, gradability, drawbar pull. Transient operation of vehicles: inertia effects, equivalent mass, equivalent moment of inertia, time taken in synchronization during change of gears, effect of flywheel inertia on acceleration, dynamic of vehicles on banked track, gyroscopic effects , net driving power.

**UNIT 3**

**Braking performance:**

Braking of vehicles, brakes applied to rear wheels, front wheel and all four wheels, motion on straight and curved path, mass transfer effects, braking efficiency, stopping distance, reaction time and stopping time, brake locking anti lock drives, calculation of mean lining pressure and heat generation during brakes.

**UNIT 4**

**Vehicle ride characteristics:**

Human response to vibration, vehicle ride models, road surface profile as a random function, frequency response function, evaluation of vehicle vertical vibration to ride comfort criterion.

**UNIT 5**

**Two wheeler dynamics:**

Stability & handling, vehicle motion ride control, various vehicle models, gyroscopic effect, effect of tyre and vehicle parameter on stability and handling characteristic.

**List of Recommended Books**


1. Vehicle Dynamics , Gillespi, Tata McGraw-Hill Publication.
2. Automotive Mechanics, Giri N.K., Khanna Publication.
3. Automotive Chassis, Heldt P.M. Chilton Company New York.
4. Vehicle Dynamics , Ellis J.R., Business Books Ltd. London.

## 6AE5 : AUTO EMISSION AND POLLUTION CONTROL

**3L** **MM:100**

**UNIT 1**

**Engine emissions and air pollution**:

Constituents of engine exhaust responsible for air pollution and their effect on human health, plant ecology, ozone layer depletion and global warming, Photochemical smog, greenhouse gases. Kyoto protocol and carbon trading. Formation of Pollutants: Combustion generated and other pollutants, general mechanisms and kinetics of formation of carbon-monoxide, unburnt hydrocarbon, oxides of nitrogen and particulate matter due to combustion, effect of air-fuel ratio on emissions, extended Zeldovitch mechanism for formation of NOx, soot and smoke formation. NOx particulate trade-off.

**UNIT 2**

**Emissions from Spark ignition engines**:

Types of emission form spark ignition engines, importance of mixture formation, lean and rich mixture, study of various mechanism of formation of unburnt hydrocarbon, effect of various design and operating variables on formation of CO, UBHC and NOx. Discussion on different technologies for reducing engine out emissions from a spark ignition engine, gasoline port injection and gasoline direct injection. Evaporative emissions and their control.

**UNIT 3**

**Emissions from Compression Ignition engines:**

Types of emissions from compression ignition engine, effect of various design and operating variables on formation of NOx, smoke and particulate matter. Discussion of various technologies for reducing engine out emissions from a compression ignition engine such as turbo charging, inter-cooling, fuel injection pressure, injection timing retard, exhaust gas recirculation (EGR) etc.

**UNIT 4**

**Exhaust After treatment:**

Need for exhaust after treatment, fundamentals of catalytic converters, three-way catalyst, diesel oxidation catalyst, diesel particulate filter, effect of fuel sulfur on after treatment devices. Emission Test Procedures: Various test cycles for emission testing of two-three wheelers, passenger cars, utility vehicles, light and heavy duty commercial vehicles used in India, Europe, Japan and USA. Test procedures for various types of evaporative emissions.

**UNIT 5**

**Study of emission standards** for two-three wheelers, passenger cars, utility vehicles, light and heavy duty commercial vehicles used in India, Europe, Japan and USA. Equipment for Emission Measurements: NDIR analyzers, Flame ionization detector, chemiluminescence's analyzer, constant volume sampling, measurement of smoke and particulate matter.

**List of Recommended Books**

1. Automobiles Pollution , Paul Degobert , SAE International.
2. Engine Emission , Pundhir B.P. , Narosa Publication

## 6AE6 : AUTOMOTIVE HEATING, VENTILATION AND AIR CONDITIONING

**3L+1T** **MM:100**

**UNIT 1**

**Air conditioning fundamentals**:,

Fundamentals of refrigeration, basics of vehicle air conditioning system, location of air conditioning component in a car – schematic layout of a refrigeration system, component like compressor, condenser, fan blower, expansion

device – expansion valve calibration , evaporator pressure regulator ,low and high pressure switch.

**Unit –2**

**Air conditioning heating system**:

Automotive heaters – manually controlled air conditioner – heater system –automatically control air conditioner – air conditioning protection with heater diagnosis chart.

**Unit –3**

**Refrigerants:**

Introduction ,classification, properties, selection criteria, commonly used refrigerants, eco friendly refrigerants, global warming and ozone forming potential of refrigerants, containers, handling of refrigerants.

**UNIT 4**

**Psychrometry:**

Introduction, Psychometric properties, Inside and outside design conditions of air conditioning system. Air distribution: introduction, factors affecting design of air distribution system, types of air distribution system, air flow through the dashboard recalculating unit, duct system, ventilation, vacuum reserve

**UNIT 5**

**Air conditioning maintenance and service :**

Cause of air conditioner failure, trouble shooting of air conditioning system, servicing heater system, removing and replacing components, leak testing, compressor service, charging and discharging, performance testing.

**List of Recommended Books**

1. Automotive air Conditioning William H. Crouse , Tata McGraw Hill publication
2. Automotive air Conditioning , Mitchell information service, PHI

## 6AE7 : AUTO TRANSMISSION LAB

**2P** **MM:100**

1. Technical Specification of two and four wheeled (Petrol and diesel) vehicle and trouble shooting chart of all the chassis and transmission components.
2. Dismantling and assembly of chassis and transmission component by using special tools measurement and comparison like clutches, gearboxes, propeller shafts, differential gearbox, steering mechanism and braking system, inspection for wear and tear, crack breakdown, servicing and cleaning and necessary adjustments.
3. Calculation of gear ratios of respective assemblies.
4. Study of torque converter.
5. Study of janny hydrostatic drive.
6. Study of Ward Leonard control system.

## 6AE8 : VEHICLE DYNAMICS LAB

**2P** **MM:75**

1. Study of Vehicle stability test.
2. To perform static and dynamic balancing on balancing setup.
3. To perform the wheel balancing test.
4. Study of various parameter at the time of application of brake ( Braking efficiency & stopping distance , Reaction time and stopping time)
5. Study of Antilock braking system.
6. Study of different steering system used in automobile.
7. Study of ride comfort in Vehicle.

## 6AE9 : AUTOMOTIVE SYSTEM AND POLLUTION LAB

**2P** **MM:100**

1. Chassis and transmission components- sketches, functions, material
2. Study of NDIR Gas analyzer and Fill
3. Study of Chemi-luminescent NOx analyzer.
4. Measurement of HC, CO, CO2, O2 using exhaust gas analyzer. Diesel smoke measurement.
5. Testing and servicing of electrical equipments and accessories; battery, generator, alternator, starter motor, ignition systems and spark plug. 6. Inspection and testing of vehicle and engines and preparation of test charts.

## 6AE10 : MACHINE DESIGN LAB-II

**2P** **MM:75**

Problem Solve:

1. Fatigue Loading
2. Helical compression tension, torsional and leaf spring
3. Design of Weldments
4. Curved Beams
5. Clutches and brakes
6. Belt Rope and Chain Drive
7. Gear Design
8. Bearing Design
9. Design of flywheel

**Syllabus for VII Semester (IV Year) B.Tech. (Automobile Engineering)**

## 7AE1 : ADVANCED IC ENGINE II

**3L+1T** **MM:100**

**UNIT 1**
**Combustion in Spark Ignition Engines:**
Thermodynamic analysis of SI engine combustion, burned mass fraction, analysis of cylinder pressure data, combustion process
characterization, flame structure and speed. Cycle-to-cycle variation-causes, effects measurement and control, Ignition systems.

**UNIT 2**
**Combustion in Compression Ignition Engines:**
Types of diesel combustion systems, direct injection systems, indirect injection systems, their comparison. Fuel injection-fuel spray behavior, overall spray structure, atomization, droplet size distributions, Sauter Mean Diameter, Spray penetration, wall wetting and its effect.

**UNIT 3**
**Modern Development in I.C. Engine:**
Diesel Engine Developments: Electronic injection systems: Distributor systems, Common Rail Fuel Injection systems; Unit injectors; multiple injections, rate shaping. Trends injection nozzle designs, sac volume, VCO nozzles.

**UNIT 4**
**Gasoline Engine Developments:**
Gasoline Port Injection (GPI). Gasoline Direct Injection (GDI) Stratifies Charge Engines, Lean Burn Engines.
**Special developments:**
Variable Valve Timing (VVT), Variable Swirls Concepts, Variable Geometry Turbochargers (VGT), two valves vs. four valve engines.

**UNIT 5**
**Unconventional Engines:**
Rotary Engines, Variable compression ratio engines, free piston
engine. Hybrid vehicles, Fuel Cells.

**List of Recommended Books**


1. I.C. Engine , Mathur and Sharma , Dhanpat Rai New Delhi.
2. I.C. Engine , V Ganeshan , Tata McGraw-Hill Publication.
3. I.C. Engine , Domkundwar, Dhanpat Rai Publication..
4. I.C. Engine, Gupta K.M, Umesh publication.

## 7AE2 : PRODUCT DEVELOPMENT

**3L** **MM:100**

**UNIT 1**
**Introduction to Product Design:**
Asimov's model, definition of production design, design by evolution, design by innovation. Essential factors for product design. Morphology of design. Process capability. Tolerance in detailed design and assembly.

**UNIT 2**
**Product Design Practice**:
Introduction, product strategies. Time to market, analysis of the product, basic design considerations, standardization, preferred numbers, simplification, role aesthetics in product design, functional design, criteria and objectives of design. Strength, stiffness and rigidity considerations in Product design, principle stress trajectories (force flow lines), balanced design, designing for uniform strength.

**UNIT 3**
**Design for production:**
Producibility requirements for machine components, design for casting, forging, presswork, role of manufacturing process in design, design of ease of machining. Design for assembly and disassembly. Optimization of Design: Design approaches, optimization by differential calculus, Lagrange multipliers, linear programming, geometric programming. Johnson's method of optimum design.

**UNIT 4**
**Ergonomic and economic factors in design:**
Human being as applicator of forces, anthropometry, design of controls, displays. Man-machine interaction; product value vs.
cost; economic considerations, economics of new product design (Samuel Elion Models).

**UNIT 5**
**Modern Approached to Product Design:**
Concurrent design, simultaneous engineering, Quality Function Deployment (QFD), Product development cycle, Program management.

**List of Recommended Books**

1. Product Design & Manufacturing ,Chatale A . K ,PHI Publication.
2. Product Development , Ulrich , Tata McGraw-Hill publication
3. Manufacturing Engineering , Ghose and Mallik , EWS publication.

## 7AE3 : CAD/CAM

**3L** **MM:100**

**UNIT 1**
**Introduction:**
Role of computers in design and manufacturing. Influence of computers in manufacturing environment. Product cycle in conventional and computerized manufacturing environment. Introduction to CAD and CAM. Advantages and disadvantages of CAD and CAM Hardware for CAD: Basic hardware structure, working structure, working principles, usages and types of hardware for CAD. Input/output devices, memory, CPU, hardcopy and storage devices.

**UNIT 2**
**N C System:**
Definition, applications, Historical background Role of Computers in Manufacturing. Numerical Control in CAM: Definition , Historical Background, basic components of NC system, Fundamentals of NC: Procedure, Coordinate system, motion control systems, Advantages of NC systems. Economic of NC. machining centers.

**UNIT 3**
**Part Programming:**
Numerical control part programming: punched tape, tape coding & format. Manual part programming, Computer aided part programming NC part programming languages. Automatically programmed, tools programming (APT). Description of compact & NC programming with interactive graphics.

**UNIT 4**
**Computer Numerical Control:**
Principle of operation of CNC, Features of CNC, Development in CNC systems, Adaptive Control, Direct Numerical Control (DNC) Standard Communication interfaces, Programmable Logic Controllers (PLCs) Communication networks, Trends* New Development in NC.

**UNIT 5**
**Robot Technology:**
Introduction, Industrial Robots, Robot physical Configuration, Basic Robot motions, Technical features such as work volume, precision of movement speed of movement, weight carrying capacity, type of drive systems, Introduction to Robot Languages, End Erectors, work cell control and interlocks, Robotic sensors, Robot applications & economics, Intelligent robots, interfacing of a vision system with a Robot.

**List of Recommended Books**

1. CAD/CAM , Ibrahim Zied, Tata McGraw-Hill Publication.

2. CAD/CAM , Groover , Tata MCGraw-Hill Publication.

3. CAD/CAM/CIM, Radhakrishanan. New Age.Publication .

## 7AE4 : MICROPROCESSOR APPLICATION IN AUTOMOBILE

**3L+1T** **MM:100**

**UNIT 1**
**Architecture**:
General 8 bit microprocessor and its architecture 8085, Z-80 and MC 6800 MPU and its pin function: Architecture-Function of different sections.

**UNIT 2**
**Instruction Set:**
Instruction format-addressing modes-instruction set of 8085 MPU TSTATE- Machine cycle and instruction cycles-Timing diagrams-Different machine cycles- Fetch and execute operations-estimation of execution times.

**UNIT 3**
**Assembly Language Programming:**
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.

**UNIT 4**
**Data Transfer Schemes:**
Interrupt structure-Programmed I/O-Interrupt driven I/O, DMASerial I/O. 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.

**UNIT 5**
**Applications:**
Data acquisitions- Temperature control-Stepper motor control-Automotive applications Engine control, Suspension system control, Driver information.

**List of Recommended Books**

1. Integrated Electronics, Milman and Holkias Tata Mc Graw-Hill Publication.
2. Microprocessor Architecture, Ramesh Goankar, Willey India.
3. Digital Principle and Application, Malvino and Leach, Tata McGraw-Hill Publication.
4. Principle Of Electronics, Mehta V.K. , S.Chand publication.

## 7AE5 : VEHICLE AERODYNAMICS AND VEHICLE BODY ENGINEERING

**3L+1T** **MM:100**

**UNIT 1**

**Introduction:**

Importance of vehicle design in modern automobile industries. Criteria for vehicle body design, Types of frame, construction details, loading points, testing of frames in bending and torsion. Different types of metal joining process used in vehicle body construction.

**UNIT 2**

**Car Body Details:**

Types : Saloon , Convertibles, Limousine, Sedan , Hatchback , Racing and sports car. Car visibility- driver's visibility, regulation , visibility test, method of improving visibility and space in cars , Safety in design of car , Car body construction. Bus Body Details : Types: Mini bus, single Decker bus, Double Decker bus, articulated bus , Bus body layout , floor height, engine location, entrance and exit , seat layout , seat dimension. Construction details- frame construction , double skin construction, types of metal section used , conventional and integral type construction.
Commercial vehicle Details: Types of body : Flat platform , drop side , fixed side , tipper body , tanker body , light commercial vehicle body types – dimension of driver seat in relation to control- Driver cabin design.

**UNIT –3**

**Vehicle aerodynamics:**

Introduction , Aerodynamics forces , Drag, Drag reduction , stability and cross winds various body optimization technique for minimum drag, Wind tunnel testing, Scale model testing,

**UNIT 4**

**Body Load:**

Symmetric & asymmetrical vertical loads in car. different load case in vehicle- Bending case , Torsion case, Combined bending and torsion , lateral loading Idealized structure – Structural surface –shear panel method.

Body material trim and mechanism: Steel sheet , timber , plastic , GRP, FRP , Properties of materials- corrosion – anticorrosion method. Selection of paints and various processes. Body trimming process- dent beating tools, riveting method, welding method. Body mechanism- door lock mechanism , window glass winding mechanism.

**UNIT 5**

**Safety in vehicle design:**

Basics of impacts protection, design for crashworthiness , front impact and side impact analysis, bumper system , energy absorbent forms. Indian Motor acts and its application- The motors vehicle acts 1988, Driving license , Registration of vehicles, Rules of the road, Motor Insurance.

**List of Recommended Books**

1. Vehicle Body Engineering , Powlosky J, Business Books.
2. Body Construction & Design , Giles J.C. , Liiffe Books Butterworth.
3. Vehicle Body Layout and Analysis , John Fenton , M. Engineering Ltd.
4. Vehicle Body Building and Drawing , Heinemann, Education Books Ltd. London

## 7AE6.1 : MECHATRONICS (ELECTIVE-I)

**3L+1T** **MM:100**

**UNIT 1**
**INTRODUCTION:**
Definition and an overview of mechatronics, design of mechatronics system. Objectives, advantage and disadvantage of mechatronics. Microprocessor based
controllers. System and design – mechatronics approach, modeling, and simulation, man – machine interface.

**UNIT 2**
**SENSORS AND SIGNAL CONDITIONING:**
Classification of transducers, development in transducers technology, ( no detailed discussion on different type of transducers), classification of sensors, principle of working and application of light sensors, proximity sensors and hall effect sensors. Concept, necessity op-amps protection, filtering, and wheat stone bridge- Digital- Multiplexer. Data acquisition.

**UNIT 3**
**MICROPROCESSOR:**
Introduction, 8085 A processor architecture and terminology – such as, CPU, memory and address, ALU, assembler, data, register, fetch cycle, write cycle, state bus, interrupts. 8085 pin diagram. Micro controller. Difference between microprocessor and micro controller.

**UNIT 4**
**ELECTRICAL ACTUATOR:**
Classification of actuator system with examples, mechanical switches. Concept of bouncing method of preventing bouncing of mechanical switches. Solenoid relays. Solid state switches-diode thyristor, triacs, transistors, and Darlington pair. Electrical actuator, stepper motor, permanent magnet motor servo motor, servo system, derives circuit, open and closed loop control.

**UNIT 5**
**HYDRAULIC ACTUATOR:**
Valves – classification, pressure control valves, pressure relief valves, pressure regulating valves, pressure sequence valve. Direction control valves – sliding spool valve, solenoid operated. Symbol of hydraulic element. Hydraulic cylinder – constructional features, classification and application. Hydraulic motor - types vane motors and piston motors, application.
EXAMPLE OF MECHATRONIC SYSTEM: Robotics, manufacturing, machine – diagnostic, road vehicles

**List of Recommended Books**


1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Bolton, W., Pearson Education
2. Mechatronics: Principles, Concepts and applications, Mahalik N.P., Tata McGraw Hill
3. Mechatronics, HMT Hand Book, Tata McGraw Hill.
4. Mechatronics, Singh and Joshi, Prentice Hall of India
5. Mechatronics: Integrated Technologies for Intelligent Machines, Smaili and Mrad, Oxford Publication.
6. Introduction to Mechatronics and Measurement Systems, Alciatore and Histand, Tata McGraw Hill
7. Mechatronics: Integrated Mechanical Electronic Systems, Ramachandran, Vijayaraghavan and Balasundaram, Wiley India Publication .
8. Mechatronics , Bradley D. A., Chapman & Hall Publication .

## 7AE6.2 : FUEL CELL, ELECTRIC AND HYBRID VEHICLE (ELECTIVE-I)

**3L+1T** **MM:100**

**UNIT 1**

**Introduction and types of Fuel cell:**

Introduction : the rational behind fuel cell development, basic principle of fuel cell, operational of fuel cell, efficiency of fuel cell, co generation of heat and power, important reaction such as hydrogen oxidation, methonal oxidation etc, Types of fuel cell: DMFC (direct methanol fuel cell),PAFC (phosphoric acid fuel cells), MCFC ( molten carbonate fuel cells), SOFC ( solid oxide fuel cells)

**UNIT 2**

**Fuel processing and application of fuel cells**:

Fuel processing- general, producing hydrogen from alcohol, producing hydrogen from hydrocarbon, hydrogen from other sources, Gas cleanup, reformer system, hydrogen storage system Engineering: fuel cell engineering, vehicle cell design, stack engineering fuel processing system application: stationary power, propulsion of vehicle, portable application

**UNIT 3**

**Electric Vehicle:**

Introduction, working. Electric car motors, electric car batteries, charging system of electric car, magna charge system. conversion system for transmission.

**UNIT 4**

**Hybrid vehicle:**

Introduction, working. Power split devices. Hybrid car performance, gasoline hybrid structure. Gasoline Vs electric power. Transmission components of hybrid vehicle. Advantage and limitation. Different types of hybrid vehicle.

**UNIT 5**

**Solar Vehicles:**

Introduction and working, photovoltaic cell, solar cell. Energy lose in solar cell. Solar powering house. Solar cost, anatomy of solar cells.

**List of Recommended Books**


1. Microbial Fuel Cell, Bruce E. Logan , Willey publication.
2. Principle of Fuel Cell, Xiangeo Li, CRC Press.
3. Non Conventional Energy, Rai G.D. Khanna Publication

## 7AE6.3 : QUALITY CONTROL(ELECTIVE I)

**3L+1T** **MM:100**

**Unit 1**
**Quality Concept And Management:**
Evolution of quality control, Quality characteristics, need of control , quality objective and quality policy, quality cost, quality of design, conformance, Objective and application of Statistical quality control, process capability analysis. Quality assurance, Concept of TQM, ISO 9000 and ISO 14000 system

**Unit 2**
**Control Chart :**
General theory of control chart, control chart for variable and attributes, Group Control chart, moving average and moving range charts, acceptance control chart, CUSUM chart, difference control charts

**Unit 3**
**Sampling Plans:**
Fundamental Concepts of acceptance sampling, multiple and sequential sampling plans, acceptance sampling by variables, sampling plans using different criteria. comparison of various types of sampling plans.

**Unit 4**
**Life testing and Reliability:**
Models of probability of equipment failure, Exponential failure, density, MTTF, Weibull failure ,concept of reliability, designing for reliability, Maintainability, Reliability measurement and test

**Unit 5**
**Quality Management:**
Philosophies of Deming , Juran, Ishikawa and Philip Crossby, Seven Quality tools, Quality circle, Kaizen, Concept of poka yoke,5 S campaign, Six sigma, Quality function deployment, Benchmarking

**List of Recommended Books**


1. Quality Planning & Analysis, Juran J.M. & Gryna F.M. Tata McGraw Hill.
2. Quality Control, Dale H. Besterfield, 8th Edition, Pearson/Prentice Hall, 2008
3. Statistical Quality Control, Grant E.L and Leavenworth Richard S., Tata McGraw-Hill, 2000
4. Introduction to Statistical Quality Control, Douglas C. Montgomery, 2nd Edition, Wiley India, 1991
5. Fundamentals of Quality Control and Improvement, Mitra, Amitava 2nd Edition,Prentice Hall, 1998
6. Reliability Engineering, Srinath, L.S., Affiliated East West Press

## 7AE6.4 : VEHICLE TRANSPORT MANAGEMENT (ELECTIVE I)

**3L+1T** **MM:100**

**UNIT 1**
**The Infrastructure:**
Road, Approach Road, National, state Highways. Traffic condition, Bus-stop, shelters, bus station. Garages layout of premises, equipment, use of machinery. Conveyance of staff. Facilities for passengers. Maintenance- preventive, breakdown, overhauling-major, minor.

**UNIT 2**
**Organization and Management**:
Forms of ownership, principle of transport management. Internal organization, centralized condition, decentralized condition (Engineering, Traffic and administration), staff administration-industrial relation, administration, requirement and training, welfare, health and safety.

**UNIT 3**
**Public relation division:**
Dissemination of information, maintaining goodwill, handling complaints, traffic advisory committees, Local contractor co-operation with the press. Facilities for the visitors, forms of publicity, Importance of quality, advertisements, signs notices and directions, specialized publicity.

**UNIT 4**
**Prevention of accidents:**
Emphasis of safe driving, annual awards bonus encouragement vehicle design, platforms layout, location of steps, scheduled route, records. Route planning: Sourcing of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule test runs, elimination of hazards factors affecting frequency, possibility single verses double deck. Timing, bus working and schedules: Time table layout uses of flat graph method of presentation preparation of vehicle, numbering determination of vehicle efficiency checking, efficiency of crew.

**UNIT 5**
**The fare structure:**
Basis of fare, historical background, effect of competition. Calculating average zone, system straight and tapered scale, fares concession system. Fare collection system. Operating Cost and types of vehicles: Classification, average speed running costs, supplementary costs, life of vehicles, factor affecting cost per vehicles km traveled.
Indian Motor vehicle Act.:

**List of Recommended Books**


1. Bus Operation , Kitchen L D., Liffle & Sones London.
2. Bus and Coach Operation , Rex w. Faulks , Butterwirth version.
3. Automobile Engineering , Gupta K.M. , Umesh publication.
4. Automobile Engineering. Gupta , R.B, Satya publication.

## 7AE7 : IC ENGINES LAB

**2P** **MM:75**

1. Assembly and dismantling of multi point fuel injection.
2. Determine the following engine performance properties for each observation: engine brake power (KW), engine brake torque (N-m), Brake specific fuel consumption (kg/kWh), and brake mean effective pressure (kPa).
3. To perform preventive maintenance of the ignition, fuel, cooling and lubricating systems.
4. Perform laboratory course covering the basics of automotive electric and electronic. Study of circuit construction emphasizing meter usage, including analog, digital and oscilloscopes.
5. To perform computerized engine control systems including sensor testing, onboard diagnosis, scan tool use and fuel injector testing, cleaning and preventive maintenance.
6. Study of electronic fuel injection system.
7. Study of Common rail direct injections engine.
8. Study of various sensor and Electronic control module used in automobile.
9. Study of Electronic fuel pump.
10. Study of alternative fuels used in I.C. Engine.

## 7AE8 : CAD/CAM LAB

**2P** **MM:75**

1. Analysis of simple automotive components by using FEM package.
2. Auto lisp programming – writing and execution of at least 3 programs (2D only)
3. Using Pro/E or any other standard solid modular getting a hardcopy of 4 different automotive 3D objects.

4. a). Study of CNC Machine and simulation of cutting/milling operations using CAM package.
   b) Machining and simulation of at least two jobs using CNC Machine /CAM package.

5. Clutch Complete design of clutch component, components and assemblies drawing using drafting software.
6. Gear Box : Gear train calculation , Layout of gear box , calculation of bearing loads and selection of bearing. Complete assembly drawing using drafting software.

## 7AE9 : BODY ENGINEERING LAB

**2P** **MM:50**

1. Perform the visibility test on the vehicle.
2. Study of different types of tool used in body shop
3. Perform the various joining processes (welding, riveting) in the body material.
4. Assembling and dismantling of various body mechanisms like door lock mechanism, window winding machine mechanism, passenger seat mechanism.
5. Perform the dent beating process on the metal sheet.
6. Study and perform the various painting process on the car.
7. Make the different scale model (Bus body model, TATA 407 model).
8. Study of Modern vehicle design.
9. Study of vehicle crash analysis.

## 7AE10 : Practical training + Industrial visit

**2P** **MM:100**

## 7AE11 : Project - I

**2/2P** **MM:50**

**Syllabus for VIII Semester (IV Year) B.Tech. (Automobile Engineering)**

## 8AE1 : ALTERNATIVE FUELS AND ENGINE TRIBOLOGY

**3L+1T** **MM:100**

**UNIT I**

**Introduction:**

Estimation of petroleum reserves, need for alternative fuels, availability and properties of alternative fuels. Merits and demerits of alternative fuels. Alcohols: properties of alcohol as SI engine fuel, ethanol and methanol, ethanol- gasoline blends,
methanol -gasoline blend, combustion characteristics in the fuel engines, performance and emission characteristics.

**UNIT II**

**Compressed natural gas, LPG and biogas,**

availability of CNG properties, modification required to use in engine- performance and emission characteristics of CNG vehicles SI and CI Engines. Use of LPG in SI engine: performance and emission for LPG. Biogas generation, properties, performance and emission characteristics, storage, handling and safety aspects,

**UNIT III**

**Bio-diesel:**

Different sources of vegetable oils use of straight vegetable oils in engine, Trans- etherification, bio-diesel, bio-diesel properties and standards, biodiesel blends. Engine performance and emission characteristics with use of biodiesel and its blends, worldwide trends in use of bio diesel.

**Hydrogen** : hydrogen as SI engine fuel, properties combustion characteristics, port injection, timed injection, direct injection of hydrogen in engines, backfire arrest, performance and emission characteristics, production, storage and handling, safety aspects.

**UNIT IV**

**Engine Tribology of Fundamentals**:

Function of engine lubrication, fundamental of lubrication regimes of lubrication-hydrodynamic, mixed and boundary lubrication, elasto hydrodynamic lubrication, description of engine components working of each of these regimes .

**UNIT V**

**Engine Lubrication System:**

Engine lubrication system and their components, bearing lubrication, lubrication of piston, ring and liners, mechanisms of lubricating oil consumption, method of measuring engine oil consume\ptin, positive crank case ventilation. Cylinder liner and its fitment, characterization and measurement of cylinder liner surface finish, oil filters- full flow and bypass filters, importance of air filter, wet and dry air filtration. Wear of different engine parts. Lubricating Oils: classification and service rating of lubricating oils, detailed study of different properties of lubricating oils, oil additives, oil drain intervals and used oil analysis, oil coolers.

**List of Recommended Books**


1. Alternative Fuels Guide Book , Becfold L., SAE International.
2. Energy today and tomorrow , Maheswar Dayal , I& B publication India
3. Fundamental of TribologyBasu , S.K. , PHI
4. Lubrication of Bearing , Redzimoyskay, SAE International.

## 8AE2 : INDUSTRIAL ROBOTICS

**3L+1T** **MM:100**

**UNIT 1**

**Introduction** :

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

**Unit –2**

**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.

**Unit –3**

**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.

**UNIT 4**

**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

**Unit –5**

**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

**List of Recommended Books**


1. Automation, Robotics & CAD/CAM, Groover M.P., Pearson Education.
2. Robotics Technology & Flexible Automation, Deb S.R., Tata McGraw Hill
3. Robotics: Control Sensing, Vision & Intelligent, King Sun Fu, TataMcGraw Hill Education Asia
4. Industrial Automation & Robotics, Gupta & Arora, Laxmi Publication.
5. Introduction to Mechatronics, Dr. Kuttan Appu Oxford University Press.
6. Introduction to Robotics: Analysis, Systems, Applications, Niku S., Dorling Kindersley India
7. Introduction to Robotics, Mechanics and Control, Craig JJ, Addison Wesley
8. Robotic Control sensing vision & Control, Gonzalz K.S., Tata McGraw-Hill
9. Industrial Robotics , Deb , Tata McGraw-Hill

## 8AE3 : AUTOMOTIVE MAINTENANCE & MANAGEMENT

**3L+1T** **MM:100**

**UNIT 1**

**Automobile maintenance:**

Importance of maintenance, scheduled and unscheduled maintenance. Preparation of check lists, analysis of breakdown, preventive measures, unit replacement system, maintenance schedule, chassis lubrication schedule, component retrieval, estimating repair cost, maintenance record, warranty period, servicing. Inspection forms. Log books. Trip sheets. Other maintenance record forms. Garage Practice: Types of service station/garage, layout of garage. Factors affecting layout, tools & equipments, transport service undertakings, design a layout for different garage.

**UNIT 2**

**Engine Maintenance:**

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

**UNIT 3**

**Chassis and drive line maintenance:**

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

**UNIT 4**

**Electric system maintenance**:

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

**UNIT 5**

**Body repair: minor body panel beating, tinkering, shouldering, Painting :**

Introduction of automotive paints , types of paints, corrosion and anticorrosion method, rubbing polishing, working of paint booth ,door lock mechanism, window glass actuation mechanism.

**List of Recommended Books**


1. Fleet Management , John Doke ,Tata McGraw-Hill
2. Advance Engine Performance and Diagnosis., James D Halderman PHI
3. Maruti Service Manual , Maruti Suzuki Ltd.
4. Automotive Mechanics , William H. Crouse, McGraw-Hill

## 8AE4.1 : FINITE ELEMENT METHODS (ELECTIVE-II)

**3L+1T** **MM:100**

**UNIT 1**

**Basic Concept of Finite element method:**

Some mathematical preliminaries: Integral formulation and variation methods, Rayleigh-Ritz and weighted residual method of variation approximation. Numerical solution of equilibrium problem by Gaussian elimination.

**UNIT 2**

**Stiffness methods: for steady state problems of discrete systems :**

(Bar, trusses, one dimensional heat transfer system) Element stiffness matrix, Assembly of elements, global stiffness matrix and its properties, Node numbering, Displacement and force Boundary conditions, Transformations matrix, Gauss elimination method

**UNIT 3**

**Displacement - Based FEM for solid mechanics:**

Derivation of finite element equilibrium equations, Langrangian elements (I-D & 2-D elements); CST, rectangle, aspect ratio shape functions, lumping of loads, compatibility and convergence requirements. Stress calculations Isoparametric Derivation of Stiffness matrices, bar and plane bilinear elements, Serendipity elements, natural coordinates, numerical integration, Co-continuity p and h refinement

**UNIT 4**

**Variation Method:**

Variation Approach for known functional of field problems Weighted Residual Methods: Point collection, sub domain collocation, methods of least square, Gale kin Application of these methods to one dimensional boundary value problems; Structures, fluid mechanics and heat transfer.

**UNIT 5**

**Finite Elements in Dynamics and Vibrations:**

Introduction, Dynamic Equations, Mass and Damping Matrices, Mass Matrices, Consistent and Diagonal, Damping, Natural frequencies and Mode Shapes.

**List of Recommended Books**


1. Text Book of Finite Element Analysis, Seshu P., Prentice Hall India.
2. Finite Element Procedure in Engineering Analysis, Bathe K.J., Prentice Hall India.
3. An Introduction to the Finite Element Method, Reddy J.N., Tata McGraw-Hill, New Delhi.
4. Concepts & Applications of Finite Element Analysis, Cook & Plesha, Wiley India New Delhi.
5. Introduction to Finite Elements in Engineering, Chandupatla & Belegundu, Prentice Hall India.
6. Fundamental of Finite Element Analysis , David V. Hutton , Tata McGraw-Hill
7. Element analysis of FEM, Logan D.L. , Thomson Learning.

## 8AE4.2: INDUSTRIAL ENGINEERING

**3L+1T** **MM:100**

**UNIT 1**

**Introduction:**

Work of F.W. Taylor, Frank and Lillian Gilbreth and others; Productivity definition, Means of increasing productivity work study, Motion Study; Definition, aims; Procedure for method study: selection of jobs; Recording Techniques: Micro motion study: Therbligs; Cychography and Chronocycle graph: Principles of motion economy. design of work place layout: Analysis in the form of a chart; operation chart; flow process chart; flow diagrams; string diagram; Man Machine chart; Two hand chart; Simon chart.

**UNIT 2**

**Work Measurement (Time Study):**

Definition; uses; procedure; time study equipment; performance rating; allowances, number of cycles to be studied. Determination of standard time: Predetermined Motion Time Systems. Job Evaluation: Objective of job evaluation; Methods of Job evaluation; Non-quantitative and quantitative.

**UNIT 3**

**Production Planning and Control:**

Types of production; function of production planning and control; planning Preplanning, sales forecasting; routing; Scheduling; dispatching and control with other departments. Wages and incentives: Characteristics of a Good wage for incentive system. Methods of wage payment Concept of wage incentive schemes, financial and non financial Holsely premium plan. Merric's Multiple piece rate system.

**UNIT 4**

**Facility Design:**

Facility location factors and evaluation of alternate location, types of plant layout and their evaluation. Line Balancing: Need, Heuristic approach for the line balancing Computerized Layout:

**UNIT 5**

**Project planning and Control:**

Network Control, CPM, PERT, control cost consideration and optimization. Resource allocation and leveling. Aggregate Production planning model:

**List of Recommended Books**


1. Motion & Time Study & Measurement of Work, Ralph, M Barnes , John Wiley & Sons
2. Operation Management: The Management of Productive System, Buffa E.S., John Willey & Sons.
3. PERT & CPM: Principles and Applications, Srinath, L.S., Affiliated East West Press.
4. Production & Operations Management ; Charry S.N., Tata McGraw Hill
5. Operations Management, Taylor Russel, Pearson Education
6. Introduction to Work Study, George Kanawaty, International Labour Office, International Labour Organization, 1983

## 8AE4.3 : EARTH MOVING EQUIPMENT (ELECTIVE-II)

**3L+1T** **MM:100**

**UNIT 1**

**Fundamentals soil and machinery:**

Equipments and operation, different types and purpose, System of Earth Moving Equipments:- (a) Engine- All systems of engine and special features like automatic timer, turbochargers, after collars etc. (b) Transmission- Basic types and planetary transmission constructional and working principles. Hydro shift automatic Trans torque converters, retarders, Trans hydraulic circuits and controls valves.

(c) Hydraulics- Basic components of hydraulic systems like pumps (types), control valves, relief valves and hydraulic motors, hydraulic cylinders.

**UNIT 2**

**(a) Final Drive**- Types of reductions, structure and function suspensions like hydraulic suspension.

**(b) Brakes and Steering-** Hydraulic power steering, main components and circuit. Tyre brakes and components and functions.

**(c) Under carriage-** Tyre and tracked vehicle, advantages and disadvantages, tractor and components.

**UNIT 3**

**Earth Moving Equipments Management-**

(a) Earth moving equipments maintenance- Type of maintenance schedules, purpose and advantages, organization set ups and documentation. (b) Method of selection of equipments- selection of machine, basic rules of matching machine, selection of equipment including the nature of operation, selection based on type of soil, based on haul distance, based on weather condition.

**UNIT 4**

**Calculation of operation capacity and estimating owning and operating cost:**

Methods of calculation operating capacity, calculation of productivity of bulldozer shovel, wheel landers and dump truck. Owing cost and operating cost.

**UNIT 5**

**Construction and working of earthmovers:-**

Tractors, Crane, Bulldozer, army tanks, Safety methods and attachments for earth moving equipments, hydraulic lift, Differential
lock. Trolley, shovel and scrapers.

**List of Recommended Books**


1. Giant Earth Moving Equipment , Eric C. Orlemann , Iconografix.
2. Automobile Engineering , Gupta R.B. , Sataya publication.
3. Automobile engineering Gupta K.M., Umes Publilcation
4. Automotive Mechanics. Giri N.K Khanna Publication

## 8AE4.4 : VEHICLE VIBRATION & NOISE CONTROL

**3L+1T** **MM:100**

**UNIT 1**

**Undamped free vibration:**

Introduction, single degree of freedom system, undamped free vibration, Natural frequency of free vibration. Raleigh method stiffness of spring elements, effect of spring mass. Damped free vibration: introduction, single degree of freedom system, different type of damping. Concept of critical damping and its importances, response study of viscous damped system for case of under damping. Critical damping and over damping logarithmic decrement.

**Unit –2**

**Forced vibrations:**

Single degree of freedom system, steady state solution with viscous damping due to harmonic force. Solution by complex algebra, concept of response reciprocating and rotating unbalance vibration isolation, Transmissibility ration, energy is dissipated by damping, equivalent viscous damping, structural damping, sharpness of resonance, base excitation. Vibration measuring instruments, accelerometer and vibrometer, whirling of shafts with and without damping, discussion of speeds above and below critical speeds.

**UNIT 3**

**System with two degree of freedom system:**

introduction, principle modes and normal modes coordinates coupling, generalized and principle coordinates. Free vibrations in terms of initial conditions, geared systems. Forced oscillations-harmonic excitation. Applications- vehicle suspension. Dynamic vibration absorber, dynamic of reciprocating engines.

**UNIT 4**

**Continuous systems:**

Introduction, vibration of spring, longitudinal vibration of rods, torsional vibrations of rods. Euler equations for beams, simple problems.

**UNIT 5**

**Noise and noise control :**

sound, noise decibel scale, pressure and density level, addition of levels, overall noise from different frequency ranges, sound level meters, perceived noise level, traffice noise index, NC curves, Building Acoustics, effect of noise on people, noise reduction, noise due to industrial equipments, important I.S codes related to noise.

**List of Recommended Books**


1. Mechanical Vibration Singh , V.P. Dhanpat Rai publication.
2. Mechanical Vibration. Rao , J.S ,New Age.
3. Vibration & Noise Control , Pujara, Dhanpat rai publication
4. Mechanical Vibration , Den Hartog, Dover Reprint 1984.

## 8AE5 : AUTO MAINTENANCE LAB

**3P** **MM:125**

1. Study and practice on service station equipments and their specifications and servicing of vehicles.
2. Study of the faults in the electrical systems such as headlights, side or parking lights, trafficator lights, electric horn, starter and charging system, wind screen wiper.
3. Simple tinkering and soldering works of body panel, study of door lock and window glass rising mechanisms.
4. Adjustment of pedal play in clutch, brake and hand brake lever and steering wheel play; air bleeding from hydraulic brakes and diesel fuel system
5. Wheel bearing, tightening and adjustment.
6. Removal and fitting of tires and tubes.
7. Drawing of general wiring diagram of various vehicles, like mopeds, scooters, motorcycles, cars.

## 8AE6 : AUTO RECONDITIONING LAB

**3P** **MM:125**

1. Study and practice of engine analyzer.
2. Study and practice of wheel alignment (Mechanical and computerized) and wheel balancing.
3. Testing of vehicle on chassis dynamometer and models on wind tunnel.
4. Study and practice on
   a. Connecting rod alignment
   b. Cylinder re-boring machine
   c. Valve re-facing machine
   d. Brake drum skimming machine
5. Study and practice on
   a. Fuel injection pump calibration equipment
   b. Nozzle tester
   c. Nozzle grinding machine
6. Study of tyre re-treading and vulcanizing.
7. Study and practice on body repair- tinkering and painting
8. Heat light focusing test and visibility test
9. Experimental study of microprocessors as applied to automobiles

**8AE7 : SEMINAR**

**2P** **MM:100**

**8AE8 : PROJECT - II**

**2P** **MM:200**