SCHEME OF TEACHING AND EXAMINATIONS

V Semester to VI Semester

B.E. IN AUTOMOBILE ENGINEERING

(AUTONOMOUS)

Approved by Board of Studies
<table>
<thead>
<tr>
<th>Semester</th>
<th>Subject code</th>
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Overview of the Vehicle Transmission system: Basic elements of Automotive transmission, layout of vehicle transmission system, Power Required for Propulsion, Various Resistances to Motion of the Automobile, Traction, tractive effort Performance curves, acceleration grade ability, drawbar pull, Numerical Problems.

Unit 02 Clutch: Necessity of clutch in an automobile, different types of clutches, friction clutches namely Single plate clutch, multi plate clutch, cone clutch, centrifugal clutch, electromagnetic clutch, hydraulic clutches, Clutch - adjustment, Clutch troubles and their causes, requirements of a clutch, Clutch materials, clutch lining Vacuum operated clutch, Numerical problems

Fluid coupling: Constructional details of various types, percentage slip, one way clutches (Over running clutch) like spring clutch, ball and roller one way clutches, necessity and field of application, working fluid requirements, fluid coupling characteristics, over running clutch. Numerical problems

Hydraulic Torque converters: Introduction to torque converters, comparisons between fluid coupling and torque converters, performance characteristics, slip, principles of torque multiplication, 3 and 4 phase torque converters, typical hydraulic transmission.

Gear box: The need for transmissions, Necessity of gear box, Calculation of gear ratios for vehicles, Performance characteristics in different gears, Desirable ratios of 3speed & 4speed gear boxes, Constructional details of , Sliding-mesh gear box, Constant-mesh gear box, synchronesh gear box, auxiliary transmissions, compound transmissions, numerical problems

Epicyclic transmission: Principle of operation, types of planetary transmission, Calculation of gear ratio in different speeds, Wilson planetary transmission, Ford-T model gear box, Pre selective mechanism, Vacuum control, pneumatic control, hydraulic control in the planetary gear system, Over drives, Numerical problems

Hydrostatic Drives: Principles of hydrostatic drives, different systems of hydrostatic drives, constant displacement pump and constant displacement motor, variable displacement pump and constant displacement motor and variable displacement motor, variable displacement pump and variable displacement motor, applications, plunger type pump and plunger type motor, advantages and limitations, typical hydrostatic drives, NELL GASGLOW transmission-hydrostatic shunt drives.

Automatic & electric transmissions: description and Working of representative types like Borg-Warner and general arrangement & description of electric transmission, their working principle & control mechanisms, limitations.

TEXT BOOKS:

REFERENCE BOOKS:
Unit 01  **Static Force Analysis:** Reaction between members without friction. Analysis of engine mechanism, four bar mechanism (without friction).  

8Hrs

Unit 02  **Friction:** Definition, Laws of solid friction: Belt drives, ratio of belt tensions, centrifugal tension, power transmitted, Effect of centrifugal tension on power transmitted and V-belt drives.  

6Hrs

Unit 03  **Dynamic Force Analysis:** Inertia force, Inertia torque, determination of inertia forces-Engine mechanism, four bar mechanism, Engine force analysis, dynamic equivalent masses, Turning Moment Diagrams and flywheel design  

8Hrs

Unit 04  **Balancing of Machinery:** Static and dynamic balancing, Balancing of single rotating mass in same plane and in different planes. Balancing of several rotating masses in same plane and in different planes.  

6Hrs

Unit 05  **Balancing of reciprocating masses.** Inertia effect of crank and connecting rod; single cylinder engine, balancing in multi cylinder-inline engine (primary & secondary forces), V-type engine; Radial engine - Direct and reverse crank method. Balancing of rigid and flexible rotors.  

6Hrs

Unit 06  **Governors:** Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power (only definitions).  

6Hrs

Unit 07  **Gyroscope:** Vectorial representation of angular motion, Gyroscopic couple, Effect of gyroscopic couple on two wheelers and four wheelers.  

6Hrs

Unit 08  **Cam dynamics:** Cam with specified contours, Analytical methods for Circular cam with flat faced follower and Tangent cam with roller follower.  

6Hrs

**TEXT BOOKS:**
1. Shigley, Joseph Edminister “Theory of Machines” Oxford publication, 3rd Edition 2005[Unit1,3,4,5,6,7,8]  

**REFERENCE BOOKS:**
1. Thomas Bevan, “Theory of Machines” CBS Publication  
INTRODUCTION: General considerations relating to chassis layout, classification of automobiles, types of cars, layouts of automobile with respect to location of power plant, weight distribution and stability, simple problems.

Frames: Car frame, construction and materials, different types of frame sections, their relative merits and demerits, truck and bus frames, conventional and integral frame, sub frame, functions of frame, frames for two wheeled automobiles, forces acting on frames.

Front axle: Functions of front axle, forces acting on front and rear axle, construction of typical front axle, types of front axle, live and dead axle, straight axle, double drop axle, full drop axle. Stub axle, types of stub axle, description of stub axle assembly, bearing loads on front axle, checking the axle beam and stub axle after accident. Calculation of dimensions of I-section of front axle.

Steering system: functions and requirements of steering system, general arrangement of steering system, components of steering system. Steering gear function, types of steering gears, steering linkage for rigid axle and independent front suspension. Power steering – Types, integral power steering, linkage power steering, reversible and irreversible steering, under steering and over steering. Wheel alignment, factors affecting wheel alignment, camber, caster, king pin inclination, toe-in & toe-out.

Braking system: Functions of brake, brake classification, drum and disc brake, parking and service brakes. Construction and operation of mechanical braking system. Hydraulic braking system, master cylinder, wheel cylinder, advantages and disadvantages of hydraulic brakes, self energizing brakes, requirements of brake fluid, types of brake fluid, bleeding in brakes, brake adjustments, brake liners, properties of liner.

Power brakes: Air brakes, layout of air brake system for bus, brake valve, unloader valve, air filter and air reservoir, brake chamber, slack adjuster, construction and working of air hydraulic brakes, engine exhaust brake, vacuum brakes and servo brakes.

Suspension system: Functions and requirements of suspension system. Front end suspension – rigid axle and independent suspension, relative merits and demerits, torque rods and stabilizers, air suspension, hydro elastic suspension. Rear end suspension – long leaf spring, transition leaf spring, coil spring rear suspension, types of suspension springs, plastic springs and telescopic shock absorber.

Wheels and tyres: Functions and requirements of wheels, wheel size, wheel center, rim, single wheel, dual wheel, inset wheel, zero set wheel and out set wheels. Disc wheel, wire wheel and alloy wheels. Tyres – function and types, tube and tubeless tyres, cross ply and radial ply construction, relative advantages and disadvantages, tyre materials, manufacturing of tyre, tyre tread pattern, tyre pressure and wear, tyre properties, causes for tyre wear.

TEXT BOOKS:
1. R.B.Guptha “Automobile engineering” –, TECH India publication, Satya Prakashan, New Delhi, 7th edition, 2006,(Unit1 & 2- Chapter 30, unit 3 & 4 - Chapter 28, unit 5 & 6 – Chapter 32, unit 7 – Chapter – 29, unit 8 – Chapter 27 )

REFERENCE BOOKS:
1. P.M.Heldt “Automotive Chassis” –, Chilton & Co.
2. P.L.Kohli “Automotive chassis and body” –, TMH
Unit 1

**Introductory concepts and definition:** Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanism.

**Conduction:** Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems. (No derivation). One dimensional steady state heat conduction – The Slab, The Cylinder, The Sphere, Composite Medium. Overall heat transfer coefficient. Thermal contact resistance. Boundary conditions of 1st, 2nd and 3rd kinds

Numerical problems and Mathematical formulation. 7 Hrs

Unit 2


Numerical problems. 6 Hrs

Unit 3

**One-dimensional Transient conduction:** Conduction in solids with negligible internal temperature gradients (Lumped system analysis). Use of transient temperature charts (Haisler’s chart) for transient conduction in slab, long cylinder and sphere. Use of transient temperature charts for transient conduction in semi-infinite solids.

Numerical problems. 6 Hrs

Unit 4

**Concepts and basic relations in boundary layers:** Flow over a body velocity boundary layer; critical Reynolds number; general expressions for drag coefficient and drag force; thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer coefficient; Nusselt number. Flow inside a duct - velocity boundary layer, hydrodynamic entrance length and hydro dynamically developed flow; flow through tubes (internal flow)(discussion only). Numericals based on empirical relation given in data handbook

**Free or Natural Convection:** Application of dimensional analysis for free convection - physical significance of Grashoff number; use of correlations free convection from or to vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres.

Numerical problems. 7 Hrs

Unit 5

**Forced Convections:** Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct use of correlations for flow over a flat plate, over a cylinder and sphere.

Numerical problems. 6 Hrs

Unit 6

**Heat Exchangers:** Classification of heat exchangers, overall heat transfer coefficient, Fouling and fouling factor. LMTD, Effectiveness - NTU methods of analysis of heat exchangers.

Numerical problems. 6 Hrs

Unit 7

**Condensation and Boiling:** Types of condensation (discussion only), Nusselt’s theory for laminar condensation on a vertical flat surface; use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; Pool boiling regimes, Pool boiling correlations. Numerical problems. 7 Hrs
Unit 8 Radiation Heat Transfer

Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-
Boltzman law, Kirchoff’s law, Planck’s law and Wein’s displacement law. Radiation heat
exchange between two parallel infinite black surfaces, between two parallel infinite gray
surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert’s law;
radiation heat exchange between two finite surfaces-configuration factor or view factor.
Numerical problems. 7 Hrs

TEXT BOOKS
edition, 1988 [Units 1 to 8]

REFERENCE BOOKS
Company, Special Indian Edition (3rd) 2007
Unit 01  

6 Hrs

Unit 02  
**Super Charging:** Objects of supercharging, Thermodynamic cycle with supercharging, supercharging Power, supercharging of S.I and C.I Engines, effect of Supercharging on performance supercharging Limits, methods of supercharging, Turbo charging, methods of turbocharging. 

6 Hrs

Unit 03  
**Introduction to Automotive Air-Conditioning system:** Introduction, principle of refrigeration, Air-Conditioning system overview, system components, electrical circuit automatic temperature control System. 

6 Hrs

Unit 04  
**Engine Trouble shooting and Remedies:** Introduction, failure of diesel engine to start, S.I Engine does not crank or cranks slowly, failure of the C.I Engine to come up to speed or develop full power, Irregular Engine speed in diesels, starting is difficult in two stroke S.I Engines, two stroke S.I runs But not performs properly, piston ring and cylinder wear, piston ring sticking, combustion chamber and crank case deposits, increased fuel consumption, reduced compression, pressure-inefficient combustion, 

4 Hrs

Unit 05  
**Engine Trouble shooting and Remedies (contd.):** Inefficient/insufficient lubrication, cooling, overcooling of pistons and cylinders-Power absorbed by auxiliaries being more than that they are supposed to consume-petrol engine tune up. 

3 Hrs

Unit 06  

5 Hrs

Unit 07  
**Manifolds, Mufflers and Air filters:** Air cleaners, oil bath type, oil-saturated type, dry type. IntakeManifold, Dual Manifolds for the V-type Engine. Exhaust system, exhaust manifold, exhaust pipes, Muffler, other Muffler types 

5 Hrs

Unit 08  
**Engine Electronics:** Introduction, Typical engine Management systems, Position, Displacement and speed sensing , Measurement of Pressure, Temperature Measurement Intake air flow Measurement Exhaust oxygen sensor 

5 Hrs

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**Text Books:**
1. Mathur, M.L and Sharma, R.P “A Course in Internal Combustion Engines” Dhanpat Rai Publications (P) Ltd., 1998: Unit01-Chapter21,22,23; Unit02- Chapter 17; unit05- Chapter 18
2. Ramalingam, K.K “Automobile Engineering”, Scitech Publication(India)Pvt.Ltd. Second Edition Unit 04- Chapter 13; unit03- Chapter 28

**References Books:**
2. Joseph Heitner “Automotive Mechanics” CBS publishers
Unit - 1  
**Energy Sources:** Exhaustible sources - crude oil, Natural gas, Inexhaustible sources - Solar energy, Wind power, Tidal Power, Geo-thermal power. Energy from Bio-gas, Synthetic fuels - only a brief introduction.  
5 Hrs

Unit - 2  
**Liquid Fuels and study of its properties:** Properties and rating of fuels, chemical energy of fuels, Reaction Equation, Properties of A/F mixture, combustion temp, combustion charts, Lead free gasolines, low and ultra – low sulphur diesels, LPG, CNG, Alcohols, Biodiesels, Gaseous Fuel Injections, Dual Fueling and Controls – CNG and Gasoline, Hydrogen and Diesel, Alcohols and Diesels etc  
7 Hrs

Unit - 3  
**Combustion of Fuels:** Combustion equation, conversion of gravimetric to volumetric analysis. Determination of theoretical minimum quantity of air for complete combustion. Determination of air fuel ratio for a given fuel. Numerical problems, flue gas analysis, Gas Chromatograph.  
6 Hrs

Unit - 4  
**Combustion in S.I Engines:** Initiation of combustion, flame velocities, effect of variables on flame propagation, normal and abnormal combustion, effects of engine variables on combustion, control of detonation, CFR engine, stratified charge combustion, concepts of lean burn engines, heat release correlations.  
7 Hrs

Unit - 5  
**Combustion in C.I. Engines:** Various stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl, squish, tumble flow, velocities, swirl measurement, and delay period correlations, types, heat release correlations.  
7 hrs

Unit - 6  
**Design consideration of combustion chamber:** features and design consideration of combustion chambers, types in SI Engines  
6 hrs

Unit - 7  
**Knock and Engine Variables:** Auto-ignition in SI and CI Engines, knock and the SI engine, knock and the SI engine, knock rating of SI and CI fuels, Antiknock agents for Gasoline, Cetane rating, performance and additives.  
7 hrs

Unit - 8  
7 Hrs

**TEXT BOOKS:**

**REFERENCE BOOKS:**
FUELS TESTING AND ENGINES LAB (AU507)

V Semester – Credits

0 0 3 1.5

PART-A

(Individual Experiments)

1. Determination of Flash and Fire Points of fuels and lubricants
2. Determination of calorific values of solid, liquid and gaseous fuels
3. Determination of viscosity of oils using Redwood, Say bolts & Torsion viscometer
4. Measurement of areas of irregular figure Using of Planimeters
5. Determination of Carbon residue and Moisture content in a fuel
6. Determination of cloud and pour points of light, medium and heavy oils.
7. Drawing of Valve and port timing diagram for a given engine

PART-B

(Group Experiments)

1. Performance tests on I.C.Engines, Calculations of IP, BP, Thermal efficiencies SFC, FP, heat balance sheet for-
   (a) Four stroke Diesel Engine
   (b) Four stroke Petrol Engine
   (c) Multicylinder Diesel/Petrol Engine,(Morse test)
   (d) Two stroke Petrol Engine
   (e) Variable Compression Ratio I.C.Engine

Scheme of Examination

ONE Question from Part-A 15 Marks
ONE Question from Part-B 25 Marks
Viva-Voce 10 Marks
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<th>Study of hand tools- sketching, materials used and their applications.</th>
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<tr>
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<td>Writing technical specifications and description of all types of automobile engines.</td>
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<tr>
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<td>Study of traffic rules as per M.V. Act 1988 and driving practice of four wheel vehicle.</td>
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<td>Trouble shooting charts for all engine components.</td>
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<tr>
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<td>Note the specifications of given engines and component standard dimensions. Dismantle &amp; assemble of engine components of SI and CI engines (Two stroke and four stroke engines) of any commercial vehicles, using special tools needed. Note procedure of dismantling &amp; assembly; identify the major components, noting their functions &amp; materials used. Measurement &amp; comparison of major components dimension with standard specifications. Inspection for wear and tear, crack, breakdown. Identify the service requirements of engine, such as decarburizing, degreasing, sparkplug cleaning, fuel injector cleaning, etc.</td>
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<td>Study (Dismantling &amp; assembly): Different carburetors, fuel injection pumps, injectors, fuel tanks, fuel filters, fuel pumps, cooling systems and lubricating systems. Identify location of above components in a vehicle and note their functions along with the brand names.</td>
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<td>Drawing general electrical wiring diagrams of scooters, motorcycles, cars which are manufactured in India</td>
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**Scheme of Examination**

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<tr>
<td>ONE Question from Unit 5</td>
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<td>ONE Question from Unit 6 &amp; 7</td>
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<tr>
<td>Viva-Voce</td>
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# OPERATIONS RESEARCH (AU601)

## VI SEMESTER - Credits

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<th>Introduction: Definitions, Area of application, Approach of programming problems using OR, Feasible, Basic feasible, optimum solutions.</th>
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<td><strong>Linear Programming:</strong> Meaning, limitations, formulating linear problems, Geometric representation of two dimensional model solutions. <strong>6Hrs</strong></td>
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<td><strong>Applications of simplex format:</strong> Table format, simplex formulations, slack, surplus and artificial variables. Method of iteration, cases of degeneracy, Duality in linear programming, characteristics of dual problem, construction of dual problem, primal-dual problem solutions, Dual simplex method. <strong>8Hrs</strong></td>
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<td><strong>Application of Transportation problems:</strong> Stepping stone method or MODI method, cases of degeneracy, inequalities in constraints, Application of Assignment problems, unbalanced assignment problems, Hungarian method, Travelling salesman problem. <strong>8Hrs</strong></td>
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<td><strong>Inventory control:</strong> General inventory problems, Deterministic models with and without shortages, graphic representations, replenishment, lead times. Ordering cost, carrying cost, EOQ. <strong>5Hrs</strong></td>
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<td><strong>Sequencing:</strong> processing of N jobs through M machines, cases of having N jobs and TWO machines jobs and THREE machines, TWO jobs and M machines. <strong>6Hrs</strong></td>
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<td><strong>Games Theory:</strong> Formulation of games, Two person-Zero sum game, games with and without saddle point. Graphical solutions (2Xn, mX2).dominance property. <strong>6Hrs</strong></td>
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<td><strong>PERT and CPM:</strong> Network construction, determination of critical path and duration, floats. PERT-estimation of project duration, variance.CPM-elements of crashing. Least cost project scheduling. Determination of maximum floe through the networks. <strong>8Hrs</strong></td>
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<td><strong>Queuing Theory:</strong> Queuing system and their characteristics. The M/M/1 Queuing system steady state performance analyzing of M/M/1 and M/M/C queuing model. <strong>5Hrs</strong></td>
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### TEXT BOOKS
1. S.D.Sharma “Operations Research” Kedar nath Ram nath 15th Edition 2005-06 [Unit 01-Chapter1, 3 Unit 02 -Chapter5, 7, 8, Unit3-Chapter11, 12, Unit 04-Chapter-21, Unit 05 Chapter-24, Unit06-Chapter-19.Unit 07-Chapter-25, Unit08-Chapter-23]

### REFERENCE BOOKS
1. Philips, Ravindran and soleberg-“principles of operations research-Theory and practice”- PHI
3. Hiller and Liberman, “Introduction to operations research”
MECHANICAL VIBRATION AND VEHICLE DYNAMICS (AU602)

VI SEMESTER – Credits 4 0 0 4

Unit – 1  
**Un-damped free vibration:** Introduction, Energy method, Newton’s method and D’Alembert’s principle Single degree of freedom system, un-damped free vibration – Natural frequency of free vibration, Rayleigh’s method, stiffness of spring elements, effects of spring mass.  
6 Hrs

Unit - 2  
**Damped free vibration:** Single degree of freedom systems, different types of damping, concept of critical damping and its importance, response study of viscous damped systems for cases of under damping and over damping, logarithmic decrement.  
6 Hrs

Unit - 3  
**Forced vibration:** Single degree of freedom systems, steady state solution with viscous damping due to harmonic force solution by complex algebra, concept of response, reciprocating an rotating unbalance, vibration isolation - transmissibility ratio, energy dissipated by damping equivalent viscous damping, Structural damping, sharpness of resonance, base excitation.  
7 Hrs

Unit - 4  
**Vibration measuring instruments and Whirling of shafts:** Accelerometers and Vibrometers, Whirling of shafts with and without air damping, Discussion of speeds above and below critical speeds.  
6 Hrs

Unit - 5  
**Systems with two degree of freedom:** Introduction, principle modes and normal modes, co-ordinate coupling, generalised and principle co-ordinate, free vibrations in terms of initial conditions, Lagrange’s equation, semi-definite systems, forced oscillations, harmonic excitation. Applications: Vehicle suspension, Dynamic vibration absorber, dynamics of reciprocating engines.  
6 Hrs

Unit - 6  
**Numerical methods for multi degree of freedom systems:** Introduction, influence coefficients, Maxwell’s reciprocal theorem, Dunkerley’s equation, orthogonality principle, method of matrix iteration  
7 Hrs

Unit - 7  
**Numerical methods for multi degree of freedom systems:** Method of determination of all the natural frequencies using sweeping matrix and orthogonality principle, Holzer’s method for systems with free, fixed free and fixed ends, Stodola method, Rayleigh-Ritz method for beam vibration  
7 Hrs

Unit - 8  
**Vehicle vibration and human comfort:** Vehicle vibration with single degree of freedom free vibration, forced vibration, vibration due to road roughness, vibration due to engine unbalance, transmissibility of engine mounting vibration with two degree of freedom, free vibration, compensated suspension systems forced vibration. Human comfortable criteria  
7 Hrs

**TEXT BOOKS**
   [Unit 1 to 7]

**REFERENCE BOOKS**
<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Credits</th>
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<tbody>
<tr>
<td>01</td>
<td><strong>Introduction</strong>: Definition, Multidisciplinary scenario, Origins of Mechatronics, Evolution of Mechatronics, An overview of Mechatronics, Design of Mechatronics systems, Measurement system, Control system, Sequential controllers, Advantages &amp; disadvantages of Mechatronics, Microprocessor Based controllers - Automatic camera, Automatic washing machine, engine management system, Programmable logic controller</td>
<td>06 Hrs</td>
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<tr>
<td>02</td>
<td><strong>Review of Transducers and sensors</strong>: Definition and classification of Transducers. (No detailed discussions on different type of Transducers). Definition and classification of Sensors. Principle of working and applications of Light Sensors, Proximity Sensors and Hall effect Sensors</td>
<td>06 Hrs</td>
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<tr>
<td>03</td>
<td><strong>Microprocessors</strong>: Introduction, Microprocessor based Digital control, Basic elements of Control systems, Terminology - CPU, Memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data, Operand, Mnemonics and opcode, Registers, Fetch cycle, Write cycle, State Bus, Interrupts, Stack and Stack pointer, Intel 8085A Microprocessor Architecture</td>
<td>07 Hrs</td>
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<tr>
<td>04</td>
<td><strong>Microcontrollers</strong>: Microcontrollers, difference between microprocessor and microcontroller, Classifications, Intel 8051 Microcontroller, Selecting a microcontroller, application-temperature measurement system.</td>
<td>07 Hrs</td>
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<td>05</td>
<td><strong>Programmable Logic Controller</strong>: Introduction, Architecture of PLC, Input/Output processing - Continuous Updating Mass Input/Output Copying. Programming, Logic Functions, Latching, Timers, Counters, Internal relays, Shift registers, Jumps, Selection of PLC</td>
<td>07 Hrs</td>
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<td>06</td>
<td><strong>Electrical Actuation system</strong>: Electrical systems, Mechanical Switches, Solid-state switches, Solenoids, DC &amp; AC motors, Stepper motors and merits and demerits.</td>
<td>07 Hrs</td>
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<td>07</td>
<td><strong>Pneumatic and Hydraulic Actuation systems</strong>: Pneumatic and Hydraulic systems, Power supplies, Directional control valves, Valve symbols - Pilot-operated valves, Directional valves, Pressure control Valves - Pressure limiting valve, Pressure Sequence valve, Cylinders, Rotary actuators</td>
<td>07 Hrs</td>
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<tr>
<td>08</td>
<td><strong>Signal Conditioning</strong>: Concepts, necessity, Op-amps, Protection, Filtering, Wheatstone bridge - Digital Signals - Multiplexer. Data acquisition - Introduction to digital signal processing - Concepts and different Methods</td>
<td>05 Hrs</td>
</tr>
</tbody>
</table>

**Text Books:**

**Reference Books:**
1. R. S. Ganokar “Microprocessor Architecture, Programming and Applications with 8085”, Penram International Publishing (India)
2. Prof. H. D. Ramachandra “Mechatronics”, M/S Subha Publications
Unit - 1  
**Engine piston:** Types of piston and materials, forces on piston, heat dissipated through piston, design of piston for petrol and diesel engine, design of piston rings, design of piston pin.  
6hrs

Unit - 2  
**Connecting rod and crank shaft:** Forces acting on connecting rod, connecting rod materials, design of connecting rod of round, rectangular and I section. Forces on crank pin, design of overhung crank shaft and crank pin.  
6hrs

Unit - 3  
**Flywheel:** functions of flywheel, turning moment diagram, coefficient of fluctuation of energy, coefficient of fluctuation of speed, maximum fluctuation of energy, size of flywheel, stresses in flywheel, centrifugal tension.  
7hrs

Unit - 4  
**Suspension springs:** Stress in helical spring, axial deflection, design of helical spring, torsion bar spring, laminated leaf spring, stresses induced in leaf spring and maximum deflection.  
7hrs

Unit - 5  
**Propeller shaft:** critical speed of propeller shaft, designed torque for the propeller shaft, effect of length – diameter ratio, size of propeller shaft. Distribution of torque in differential, power developed at a single road wheel, transmission efficiency.  
7hrs

Unit - 6  
**Clutch:** Functions and classification of clutch, design of friction clutch, torque transmitted by single plate, multiplate, cone and centrifugal clutch.  
6hrs

Unit - 7  
**Curved Beams:** Stresses in curved beams of standard cross sections used in crane hook, punching presses & clamps, closed rings and links.  
6hrs

Unit - 8  
**Automotive Brakes:** Energy of motion and frictional force, brake balance, stopping distance, braking efficiency, braking of vehicles- brakes applied to rear wheels, front wheels and all wheels. Theory of internal shoe brake, calculation of mean lining pressure and heat generation during braking operation.  
8hrs

**Text Books:**

1. R.B.Gupta “Auto Design”, Satya Prakashan, Tech India Publications Reprint edition-2006, New Delhi, 2006. (unit 1 & 2 – Chapter 2, unit 3 – Chapter 3, unit 4 – Chapter 11, unit 5 – Chapter 10 & 18, unit 6 – Chapter 8, unit 8 – Chapter 12)

**Reference Books:**

1. Trikha, “Machine design” exercises 3rd edition, Khanna publishers, Delhi
Unit 01  **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, Introduction to CAM. Advantages and disadvantages of CAD and CAM  

5 Hrs

Unit 02  **Hardware for CAD**: Basic Hardware structure, Working principles, usage and types of hardware for CAD – Input devices, output devices, memory, CPU, hardcopy and storage devices.

5 Hrs

Unit 03  **Computer graphics**: Software configuration of a graphic system, function of graphics package, construction of geometry, wire frame and solid modeling. Geometry transformation – two dimensional and three dimensional transformation, translation, scaling, reflection, rotation, CAD/CAM integration. Desirable modeling facilities. Introduction to exchange of modeling data – Basic features of IGES, STEP, DXF, DMIS

8 Hrs

Unit 04  **Geometric Modelling**: Requirement of Geometric Modelling, Geometric modelling- Wire frame, Surface and Solid models - CSG and B-REP Techniques - Features of Solid Modelling Packages - Parametric and features - Interfaces to drafting, Design Analysis.

6 Hrs

Unit 05  **NC, CNC, DNC Technologies**: NC, CNC, DNC, modes, NC elements, advantages and limitations of NC, CNC. Functions of computer in DNC.

6 Hrs

Unit 06  **CNC Tooling and machine tools**: cutting tool materials, Turning tool geometry, milling tooling system, tool presetting, Automatic Tool Changers, work holding. Overview of different CNC machining centers, CNC turning centers, high speed machine tools

8 Hrs

Unit 07  **CNC Programming**: Part program fundamentals-steps involved in development of a part program. Manual part programming, milling, turning, turning center programming.

7 Hrs

Unit 08  **Introduction to Finite element analysis**: Introduction, basic concepts, discretization, element types, nodes and degrees of freedom mesh generation, constraints, loads, preprocessing, and application to static analysis.

7 Hrs

**Text Books:**

**Reference Books:**
Unit 01  **Air conditioning Fundamentals:** Basic air conditioning system, - Air conditioning principles, Air-conditioning types, temperature and pressure fundamentals, types of compressors and refrigerants.  

Unit 02  **Air Conditioning Systems:** Classification, layouts, central I unitary air conditioning systems, components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems, Automotive heaters, Types, Heater Systems, Air conditioning protection, Engine protection.

Unit 03  **Psychrometrics:** Definition, properties of air-vapour mixtures, Psychrometric chart and representation of various process

Unit 04  **Load Analysis:** Outside& inside design consideration, factors forming the load on refrigeration & air conditioning systems, cooling & heating load calculations, load calculations for automobiles, effect of air conditioning load on engine performance.

Unit 05  **Air Distribution Systems:** Distribution duct system, sizing, supply / return ducts, type of grills, diffusers, ventilation, air noise level, layout of duct systems for automobiles and their impact on load calculations.

Unit 06  **Air Routing & Temperature Control:** Objectives, evaporator air flow, through the re-circulating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control of air handling systems.

Unit 07  **Air conditioning service:** Air conditioner maintenance & service- causes of air conditioner failure, leak testing guide, discharging the system, Evacuating the system, charging the system, servicing heater system, removing & replacing components, trouble shooting of air conditioning system, compressor service, methods of dehydration, charging & testing.

Unit 08  **Air Conditioning Control:** Common control such as thermostats, humidistat, control dampers, pressure cut outs, relays

**Text Books:**
1. Mark Schnubel, "Automotive Heating & Air Conditioning", Thomson Delmar Learning, 3rd edition, NY[Unit1,2,5,6,7,8].

**Reference Books:**
1. Boyace H. Dwiggins, "Automotive Air – conditioning”
Elective A                             TOTAL QUALITY MANAGEMENT (AU653)

VI Semester – Credits 4 0 0 4

Unit 01  Evolution of Total Quality Management
Introduction – Definition, basic approach, contribution of pioneers of total quality management, TQM frame work, historical review, benefits of TQM, TQM structure, TQM organization

Unit 02  Leadership: Characteristics of quality leaders, Deming’s philosophy, role of TQM leaderships- Customers satisfaction, customers perception, using customers complaints, feedback, employee involvement, role of motivation, suggestion system, performance appraisal, continuous process improvement, Jurans trilogy, PDSA cycle, problem solving methods Imai’s Kaizen, Reengineering, six sigma

Unit 03  Tools & Techniques of TQM: Bench marking, definition, process of bench marking, Quality Management Systems, ISO-9000, Series of standards, implementation and documentation of ISO-9000, Introduction to QFD and QFD process, Quality by design, Rationale for implementation of quality by design, TQM exemplary organization, FMEA(Failure Mode and Effect Analysis) Design FMEA and process FMEA studies.

Unit 04  Tools of TQM: Basic tools of quality control, control charts for variables, construction, interpretation, analysis using X-R control charts, process capability estimation, process capability indices, process improvement through problem analysis (intensive coverage)

Unit 05  Control charts for attributes: Construction, interpretation and analysis of P-chart, NP-chart, C-chart, U-chart, process improvement through problem analysis (Intensive coverage)

Unit 06  Experimental Design: One factor designs, two factors designs, Orthogonal Design, full factorial and fractional factorial design, Taguchi’s philosophy of quality engineering, loss function, orthogonal array, signal to noise ratio, parameter design, tolerance design(Basic conceptual treatment)

Text Books:
2. Grant Levenworth “Statistical Quality Control” 2004

Reference books
1. Douglas C. Mantego Mary “Statistical Quality Control” 2000
2. Shoji Shiba Productivity “A New American TQM-four Practical Revolutions in management”
Unit 01  Introduction: Types of energy sources, their availability, need of alternative energy sources, availability merits and limitations of solar energy, wind energy, ocean energy, biomass and hydrogen energy.  

Unit 02  Solar energy: solar energy geometry, solar radiation measurement devices, solar energy collectors, types of collectors, direct application of solar energy, solar energy storage systems, P-V effect solar cells and characteristics. Application of solar energy for automobiles.  

Unit 03  Biomass energy: Definition of biomass, types of biomass, biomass conversion techniques, bio gas, biogas generation processes, types of biogas plants, construction and working, application of biogas for IC engines, modifications needed. Vegetable oils, Types - Properties – Biodiesel Esterification – Performance in Engines.  

Unit 04  Wind energy: Introduction, principle of wind energy conversion, types of wind mills, relative advantages and limitations, factors considered for site selection, application of wind energy.  

Unit 05  Hydrogen energy: Properties and thermodynamics of water splitting, Hydrogen production methods, problems associated in use of hydrogen fuel, Storage and Transportation methods, Precautions and safety for use.  

Unit 06  Hydrogen energy(contd.,)Combustion, emission and performance characteristics of hydrogen engine, engine modifications required. Fuel cells, types of fuel cells, their characteristics, requirements and applications of fuel cells.  

Unit 07  Properties of alcohols: production of ethanol and methanol, performance of IC engines using ethanol and methanol blends, production and properties of natural gas and LPG. Advantages and disadvantages of using natural gas and LPG as fuel in IC engine. Comparison with respect to conventional fuel.  

Unit 08  Electric vehicles: Requirements, features of different electric vehicles available in India, design of electric vehicle, components, types of batteries and power plant. Advantages, disadvantages and future prospects of electric vehicles.  

Text Books:  
1. G.D.Rai, “Non conventional energy sources” –Khanna Pub, New Delhi[Unit1,3-8]  
2. William Hamilton “Electric Automobiles”, PHI  

Reference books  
Unit 01  **Historical background**: Introduction, growth of network, trams, trolley buses. Infrastructure like road – approach road, highways- national, state, district. Traffic congestion, pedestrians, febrailikes, marlings, shopping centres, bus-stops, bus-stations, garages-layout, equipment, machineries, facilities for passengers. Maintenance – preventive, breakdown, condition monitoring, overhaul –major, minor, repair, replacement  8 Hrs

Unit 02  **Management**: forms of ownership, principle of transport, management –internal organization, centralized condition, decentralized condition (Engineering, traffic, administration), administration, recruitment and training, industrial relation, welfare, health and safety 6 hrs

Unit 03  **Public relations divisions**: Dissemination of information, maintaining goodwill-handling complaints, traffic advisory committees-local contractors co-operation with the press news and articles, facilities for visitors-forms of publicity, importance of quality, inter departmental liaison advertisements, signs, notice and directions, general appearance of premises, specialized publicity.  6 hrs

Unit 04  **Prevention of accidents**: Motivation – Positive and Negative motivation, Emphasis of safe driving annual awards, bonus encouragement, Vehicle design, platform layout Safety devices.  6 hrs

Unit 05  **Route planning**: Source of traffic, town planning, turning points, stopping places, shelters, estimation of traffic flow- frequency, direction, volume of traffic.  5 Hrs

Unit 06  **Timing, working and schedules**: Time table layout, use of flat graph, preparation of crew and vehicle schedule preparation, co-operation with employers, use of vehicle running, numbering, determination of vehicle efficiency, checking efficiency of crew, duty arrangements.  6 hrs

Unit 07  **Fare collection systems & Fare structure**: Principle of collection, types of collection systems-bell punch, bellgraphic, verometer, ticket-box systems, single, double box, way bill, personal and common stock, flat fare method. Fare structure Basis on historical background, effects of competition and control. Calculating average zone system, straight scale and tapered scale, elastic and inelastic demands, concession fares, anomalies, double booking 8 Hrs

Unit 08  **Operating cost**: Classification of costs, average speed running costs, supplementary costs, depreciation, life of vehicles, vehicle mile incidence of wages and overheads, 100 seat mile basis, average seating capacity, vehicle size and spread overs, types of vehicle economic considerations, statutory procedure taxes and hires. Motor vehicle act 1988 8 Hrs

**Text Books:**
1. L D KITCHEN “Bus operation” ,ILIFFE & sons , London[[Unit1-8]
2. REX W FAULKS “Bus & coach operation” , , butterworth version, 1987, london

**Reference books**
1.COMPENDIUM OF TRANSPORT TERMS- CIRT PUNE
2.IJTM – Journals
Unit - 1  
**Introduction to Structural Mechanics:** Basic Principles of Structural mechanics: Equilibrium conditions, Stresses and equilibrium, Boundary conditions, Strain-displacement relations, Stress-strain relations, Temperature effects. Plane stress and plane strain, Principle of virtual work, Energy principles. Application to finite element method.  
08 hours

Unit - 2  
**Matrix Algebra and Gaussian Elimination:** Row and column vectors, Multiplication by a scalar, Matrix multiplication, Transposition, Differentiation and integration, Square matrix, Diagonal matrix, Identity matrix, Symmetric matrix, Upper triangle matrix, Determinant of a matrix, Matrix inversion, Eigen values and Eigen vectors, Gaussian elimination and problems on Gaussian elimination.  
08 Hours

Unit - 3  
**Finite Element Method:** Steps in FEM, Applications of FEM, discretisation, various consideration for discretisation, Different types of elements 1D,2D, and 3D elements, Shape functions and derivation of shape function for only 1D element. Discussion on 1D linear, Quadratic and Cubic elements. Convergence requirements.  
06Hours

Unit - 4  
**Analysis and Solution Technique:** Derivation of element stiffness matrix, Assemble of elements, Direct stiffness method, Gaussian elimination and matrix decomposition. Element stiffness and global stiffness matrix. Problems on spring systems.  
06Hours

Unit - 5  
**One Dimensional Analysis:** Introduction, Finite element modeling, element division, numbering scheme, coordinates and shape functions. Problems on 1D element using direct stiffness method and solution using Gaussian elimination approach  
06 Hours

Unit - 6  
06 Hours

Unit - 7  
**Finite Element Equations and Boundary Conditions:** Types of boundary conditions, Elimination approach and penalty approach.  
06 Hours

Unit - 8  
**Finite Element Analysis of Trusses:** Truss element, Derivation of stiffness matrix for truss element, Direction cosines, Problems on simple trusses.  
06 Hours

**Text Books:**

**Reference Books:**
MACHINE SHOP (AU606)

VI Semester - Credits

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Part of Examination:

1. **PART-A**
   - Plain Turning, Taper Turning, Step Turning, Thread Cutting, Facing, Knurling, Eccentric Turning using lathe.

2. **PART-B**
   - Cutting of gear teeth using milling machine.

3. Cutting of V-groove / Dovetail / Rectangular groove using shaping machine.

4. Demonstration of surface grinding

**Scheme of Examination:**

- One model from part-A : 30 marks
- One model from part-B : 10 marks
- Viva Voce : 10 marks
- **Total** : 50 marks
AUTOMOTIVE CHASSIS COMPONENT LAB (AU607)

VI Semester – Credits

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<tr>
<td>0</td>
<td>Writing technical specification of two wheeled and four wheeled vehicles (at least 10 vehicles)</td>
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<tr>
<td>1</td>
<td>Drawing the layouts of chassis frames of cars, bus (front engine &amp; rear engine), truck and articulated vehicles</td>
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<td>2</td>
<td>Dismantling, cleaning, inspection for wear and tear, servicing and assembling of single plate clutch and multiplate clutch. Checking the clutch springs and Clutch adjustments.</td>
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<td>3</td>
<td>Dismantling, cleaning, inspection for wear and tear, servicing and assembling of different types of gear box and calculation of gear ratios.</td>
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<td>4</td>
<td>Dismantling, cleaning, inspection for wear and tear, servicing and assembling of propeller shaft assembly including universal joint and slip joint.</td>
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<td>5</td>
<td>Dismantling, cleaning, inspection for wear and tear, servicing and assembling of final drive and differential</td>
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<td>6</td>
<td>Dismantling, cleaning, inspection for wear and tear, servicing and assembling of steering system and steering gears.</td>
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<td>7</td>
<td>Dismantling, cleaning, inspection for wear and tear, servicing and assembling of braking system, bleeding in hydraulic brakes</td>
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<td>8</td>
<td>Removing the wheels from the vehicle, inspection for wear of tyre tread, inspection of tube, vulcanizing the tube, refitting of wheel on vehicle</td>
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<tr>
<td>9</td>
<td>Dismantling, cleaning, inspection for wear and tear, servicing and assembling of front independent suspension, shock absorber and leaf spring suspension system</td>
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