

**SHIVAJI UNIVERSITY, KOLHAPUR****Implemented from June, 2005****M.E. (Automobile Engineering)****Semester– I**

Sr. No.	Name of the Subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	Oral	
1	Design of Experiments & Research Methodology	3	1	25	100	--	125
2	Automotive Engines & Emission	3	1	25	100	--	125
3	Theory of Elasticity & Reliability	3	1	25	100	--	125
4	Transmission System Theory & Design	4	2	25	100	--	125
5	Elective – I	3	1	25	100	--	125
6	Seminar – I	--	2	25	--	--	25
Total		16	8	150	500	--	650

L – Lecture, T/P – Tutorial / Practical, T/W – Term Work, TP – Theory Examination

**Electives I :**

1. Finite Element Analysis
2. Hydraulic & Pneumatic Systems
3. Combustion Engineering
4. Vehicle Instrumentation & Testing
5. Automobile Air Conditioning

**Semester – II**

Sr. No.	Name of the Subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	Oral	
1	Engine Design	3	1	25	100	--	125
2	Chassis & Body Engg.	3	1	25	100	--	125
3	Vehicle Dynamics	4	1	25	100	--	125
4	Noise & Vibration	4	1	25	100	--	125
5	Elective – II	3	1	25	100	--	125
6	Seminar – II	--	2	25	--	--	25
7	Industrial Training *	--	--	--	--	--	--
Total		17	7	150	500	--	650

**Electives II :**

1. Computational Fluid Dynamics
2. Human Resource Development
3. Advanced Automotive Electronics
4. Automotive Maintenance & Management
5. Tribology

\* Report of Industrial training undertaken in the vacation after Semester II, is to be submitted in Semester-III.

**Semester – III**

Sr. No.	Name of the Subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	Oral	
1	Industrial Training Report	--	--	50	--	--	50
2	Seminar – III	--	1	50	--	--	50
3	Dissertation – Phase I	--	4	50	--	--	50
Total		--	5	150	--	--	150

**Semester – IV**

Sr. No.	Name of the Subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	Oral	
1	Dissertation	--	5	100	--	200	300
Total		--	5	100	--	200	300

**Implemented from June, 2005****M.E. (Automobile) – Semester - I****1. Design of Experiments & Research Methodology**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Research Concepts: Meaning, objectives, motivation, type of research, approaches, research (descriptive research, conceptual, theoretical, applied and experimental).

Formation of Research Task: literature review, importance and methods, sources, quantification of cause-effect relations, discussions, wheel study, laboratory experiments, critical analysis of already generated facts, hypothetical proposal for future development and testing, selection of research task, prioritization of research.

Mathematical Modeling and Simulation: concept of modeling, classification of mathematical models, modeling with ordinary differential equations, difference equations, partial differential equations, graphs, simulation: concept, types (quantitative , experimental, computer, fuzzy theory, statistical) processes of formulation of model based on simulation.

Experimental Modeling:

- a) Definition of experimental design, examples, single factor experiments blocking and Nuisance factors, guidelines for designing experiments.
- b) General model of process: I/P factors/ variables, O/P parameters /variables controllable/uncontrollable variables, dependent/independent variables, experimental validity.
- c) Process optimization and design experiments methods for study of response surface, first order design, determining optimum combination of factors, method of steepest ascent, Taguchi approach to parameter design.

Analysis of results (parametric and nonparametric, descriptive and inferential data): types of data, collection of data (normal distribution, calculation of co relation coefficient) data processing, analysis, error analysis, meaning, different methods: analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity/nonlinearity of model, testing adequacy of model. Testing model / hypothesis, use of computational tools, software for research work.

Report writing: types of report, layout of research report, interpretation of results, style manuals, layout and format, style of writing, typing, references, paginations, table, figures, conclusions, appendices, writing research paper for publication based on dissertation / research work.

Landscape of Creativity: convergent vs divergent thinking, creativity, creativity vs intelligence, creativity abilities, creativity and madness, determination of creativity, increasing creativity, creativity achievements, techniques of creativity, collective creativity.

**Term Work :**

The term work is expected to facilitate the students to identify a dissertation topic, to carryout literature review, plan and schedule the dissertation work and prepare him/her for report writing. The term work be preferably based on following topics.

- a) Study of research paper and literature review.
- b) Assignments on data collection, processing, analysis, interpretation, inferences and conclusions.
- c) Assignment on design of experiments.
- d) Assignments on modeling and simulation of an Engineering problem.
- e) Designing and performing an experiment on any engineering problem.

**Reference Books**

1. Willkinsion K.P. L., Bhandarkar, "Formulation of Hypothesis", Himalaya publishing, Mumbai.
2. Schank Fr, "Theories of Engineering Experiments", Tata McGraw Hill.
3. Douglas Montgomery, "Design of Experiments"
4. "Introduction to SQC" John Willy & sons.
5. Cochran & cocks, "Experimental Design", John Willy & sons.
6. John W. Besr and James V. Kahn, "Research in Education", PHI publication.
7. Adler and Granovky, "Optimization of Engineering Experiments", MIR Publications.
8. S. S. Rao, "Optimization Theory & Applications", Wiley Estern Ltd. ND.
9. C. R. Kothari, "Research Methodology", Willy Estern Ltd. ND.
10. P. D. Kulkarni, "Independent Study Techniques", TTTI Chandigardh

**M.E. (Automobile) Semester - I****2. Automotive Engines & Emission**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Engine Basic Theory: Engine types and their operation, classification, Properties of I.C. engine fuels, Actual cycle, air fuel cycle, combustion charts (Equilibrium), Two stroke engines, four stroke engine, characteristics of engines, air capacity of engine, valve timing diagram, supercharging, MPFI, VVT, cam less engine,

Fuel Supply, Ignition, Cooling and Lubrication Systems – Theory of carburetion and carburetors, mixture distribution, petrol injection, diesel fuel injection pumps, conventional and electronic ignition systems for SI engines, air cooling and water cooling, design aspects, forced feed lubrication system

Air Motion Combustion and Combustion Chambers : Swirl and turbulence – swirl generation, combustion in SI & CI engines, flame travel and detonation, Ignition delay, Knock in CI engines, combustion chamber design

Air Pollution due to Automobile Exhaust : Sources of Emission, Exhaust gas constituents & analysis, Ingredients responsible for air pollution, Smoke, odor, Smog formation.

Exhaust Emission Control: Basic method of emission control, catalytic converter, After burners, reactor manifold, air injection, crank case emission control, evaporative loss control, Exhaust gas recirculation, Fuel additives.

Pollution Norms : European pollution norms, Indian pollution norms as per Central Motor Vehicle Rules (C.M.V.R.).

Instrumentation for Exhaust Emission Measurement: Measurement procedure, Sampling Methods, Orsat Apparatus, Infrared Gas analyzer, Flame Ionization Detector (FID), Smoke meters.

Alternative Fuels : CNG, LPG, Bio-Diesel, Hydrogen, fuel cells, Eco-friendly vehicles, Electric & Solar operated vehicle

Stratified Charged, Low heat rejection engine, Sankey plot, four / three valve engine, OHC engine, governing of automobile engine, New engine technology, Recent developments in I. C. engines

**Term Work :**

Assignments / seminars based on advanced topics.

**Reference Books**

1. Introduction to Internal Combustion Engines”, Richard Stone, McMillan, London
2. Vehicle and Engine Technology – Hein Heister
3. Advance Vehicle Technology - Hein Heister
4. I. C. Engine & Air Pollution – E. F. Obert, Harper & Row Publishers, New York
5. I. C. Engines – C. Fayette Taylor & Edward S. Taylor, International text book com.
6. I.C. Engine by Maleev V. L., McGraw Hill Book, Co.
7. I. C. Engines – Ferguson
8. S. I. Engine – Fuel Injection Development - Charles A. Fisher, Chapman & Hall
9. Automotive Engines - Herbert E. Ellinger
10. Automobile Engg. Volume – I , American Technical Society, Chicago
11. Internal Combustion Engines Fundamentals – John B. Heyhood, McGraw Hill

**M.E. (Automobile) Semester - I**  
**3. Theory of Elasticity & Reliability**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

**Stress – Strain :** Introduction, stress and strain sensors, strain displacement relation for plane stress and plain strain problems of elasticity, equation of equilibrium, compactability condition, stress function, simple two dimensional problems of elasticity, Analysis of torsion of circular and non-circular sections

**Fatigue and Fracture :** Introduction to fatigue and fracture mechanics of ductile and brittle fractures mechanism of fatigue failure, factors affecting fatigue, methods of improving fatigue strength, cumulative damage theories, linear elastic fracture mechanics, finite life, infinite life, design of machine components

**Creep :** Mechanism of creep failure, Constant load constant temperature tests, Extrapolation of creep and creep rupture curves, Creep relaxation, influence of combined load in different directions, design of machine element used in high temperature services.

**Environmental Considerations in Design :** Corrosion, corrosion under stress, fretting corrosion and effects of other chemicals, Methods of improving corrosion resistance.

**Reliability Engineering:** Concepts of reliability, Statistical Models of reliability, Reliability of hazard functions, System reliability, Redundancy techniques in system design, Failure modes, effects & criticality analysis, Fault tree analysis, Event tree analysis, Design review & validation, Design for reliability

**Term Work :**

Assignments / seminars based on advanced topics.

**Reference Books**

1. Advances in Engineering Vol. 4 – Fatigue Design Handbook (SAE)
2. Failure of Material in Mechanical Design – J. A. Collins
3. Experimental Stress Analysis – J.W. Bally & W. F. Riley
4. Principles of Reliability – Pierusehka
5. Practical Reliability Engineering – Patrick D.T.O. Conner
6. Reliability Based Design – S. S. Rao

## **4. Transmission System Theory & Design**

Teaching scheme :

Lectures: 4hrs/week

Practical: 2hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Tyre selection, air resistance, rolling resistance, requirement of engine power, transmission system layout, four wheel drive, transfer case

Transmission systems : Clutch, types of clutch, clutch design, Gear box, types of gear boxes, gear box design, overdrive gears, Fluid flywheel & torque converter, Epicyclic gear box, semi-automatic & automatic transmission

Propeller shaft, design of propeller shaft, slip joint, universal joint, Final drive, differential, Dead & live axle, axle design, Constant velocity joints

Braking system – types of brakes, brake-actuating mechanisms, factors affecting brake performance, power & power assisted brakes, Brake system design, recent developments in transmission & braking system

Steering systems : Front axle types, constructional details, front wheel geometry, Condition for True rolling, skidding, steering linkages for conventional & independent suspensions, turning radius, wheel wobble and shimmy, power and power assisted steering,

### **Term Work**

Assignment based on - Design of major transmission systems & braking system components

### **Reference Books**

1. The Automotive Chassis – Engineering Principle – Reimpell J.
2. Automotive Chassis – Design & Calculation – P. Lukin, G. Gasparyants, V. Rodionov, MIR Publishing, Moskow
3. Automotive Chassis – P. M. Heldt, Chilton Co. NK
4. Mechanics for Road Vehicles – W. Steed, Illiffe Books Ltd., London

## **Elective I i) Finite Element Analysis**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Introduction : Basic concepts of FEM – Historical background, relevance and scope for FEM – need for approximation, weighted residual, Ritz and Galerkin method, variational, weak formation

General procedure of FEM : Discretization, interpolation, shape function, formulation of element characteristics matrices, assembly and solution

Formulation of element characteristic matrices and vectors for elasticity problems : One dimensional elasticity – two dimensional elasticity – three dimensional elasticity, axisymmetric elasticity

Formulation of element characteristics matrices and vectors for field problems, thermal problems – one dimensional, two dimensional and three dimensional heat transfer – axisymmetric heat transfer – torsion problems

Higher order and isoparametric formulations : Natural coordinates system and numerical integration – higher order one – dimensional, two – dimensional and three dimensional elements – structural beam, plate and shell elements- isoparametric elements – isoparametric formulation

Computer Implementation: An overview of FE analysis program, preprocessing, solution, post processing.

### **Term Work :**

Assignments / seminars based on advanced topics.

### **Recommended Books :**

1. An Introduction to the Finite Element Method- J. N. Reddy, McGraw Hill
2. The Finite Element Method in Engineering- S. S. Rao, Pergaman Press.
3. Finite Element Analysis Theory and Practice- M. J. Fagan, Longman Scientific and Technology.
4. Concept and Applications of Finite Element Analysis- R. D. Cook, John Wiley and sons Inc.
5. Finite Element Handbook – H. Kardestuncer
6. Rajasekaran. Finite Element Analysis in Engineering Design. Wheeler Publishing, New Delhi.
7. K. Bathe. Finite Element Procedures. Prentice-Hall of India (P) Ltd., New Delhi.
8. T R Chandrupatla and A D Belegundu. Introduction to Finite Elements in Engineering. Prentice-Hall of India (P) Ltd., New Delhi.
9. O C Zienkiewicz. The Finite Element Method. Tata McGraw-Hill Publishing Co Ltd., New Delhi.

**M.E. (Automobile) Semester – I****Elective I ii) Hydraulic & Pneumatic Systems**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Introduction to fluid power – Classification, application in various fluids of engineering, various hydraulics and pneumatic ISO/JIC Symbols, transmission of power at static and dynamic states,

Types of hydraulic fluids and their properties, effect of temperature on fluids.

Hydraulic system elements

Control of fluid power elements-

- Requirement of pressure control, direction control, flow control valves.
- Principle of pressure control valves, direction control valves, pilot operated, relief, pressure reducing, quick exhaust, sequence valves, flow control valves and their types, meter-in and meter-out circuit and flow through circuit.
- Types of direction control valves – two way two position, four way two position, four way three position, open center,, close center, tandem center, manual operated, solenoid, pilot operated direction control valves, check valves.
- Actuators – linear and rotary, hydraulic motors, types of hydraulic cylinders and their mountings.
- Calculation of piston velocity, thrust under static and dynamic operation and application, consideration of friction and inertia loads.

Hydraulic servo-system for rotary and linear motion.

Pneumatic Systems : Application of pneumatics, physical principles, basic requirement of pneumatic system. Comparison with hydraulic systems. Elements of Pneumatics, Air compressors, Pneumatic control valves, Pneumatic actuators - types and the mountings, Air motors – types,

Pneumatic circuits – Basic pneumatic circuit, impulse operation, speed control, pneumatic motor circuit, sequencing of motion, time delay circuits and their applications.

Pneumatic servo-system for linear and rotary motion.

Typical Automotive Applications : Hydraulic tipping mechanism, power steering, fork lift hydraulic gear, hydro-pneumatic suspension

Maintenance and trouble shooting of hydraulic & pneumatic circuits.

Introduction to fluidics-study of simple logic gates, turbulence, amplifiers, pneumatic sensors and applications.

**Term Work**

Assignments / seminars based on advanced topics.

**Recommended Books**

- Basic fluid power- D.A. Pease-PHI
- Industrial Hydraulic & pneumatics – J.J. Pippenger - McGraw Hill
- Fluid with applications – A. Esposito- PHI
- Oil Hydraulics – B Lal- Intl- Literature
- Fluid power Design Hand book – Yeaple
- Industrial Hydraulic Manual Vicker Sperry
- Practical guide to Fluid Power H.S. Stewart
- ISO 1219 Fluid systems and components
- Hydraulic & pneumatics- Andrew Parr-Jaico Publishing House.



**M.E. (Automobile) Semester – I****Elective I   iii) Combustion Engineering**

Teaching scheme :

Lectures: 3 hrs/week

Practical: 1 hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Scope and history of combustion, Fuels, Thermodynamics of combustion, Chemical kinetics of combustion, rate of reactions, chain reactions, opposing reactions, consecutive reactions, competitive reactions, Conservation equation for multi component reacting systems,

Combustion of gaseous & vaporized fuels, gas –fired furnace combustion, Premixed charge engine combustion, Detonation of gaseous mixture

Premixed laminar flames, Gaseous diffusion flames & combustion of a single liquid fuel droplet, Turbulent flames, combustion in two – phase flame systems, Chemically reacting boundary layer flows, Ignition

Combustion of liquid fuels, spray formation & droplet behavior, Oil – fired furnace combustion, gas turbine spray combustion, direct injection engine combustion, detonation of liquid – gaseous mixture, combustion of solid fuels,

**Term Work :**

Assignments / seminars based on advanced topics.

**Recommended Books :**

1. Combustion Engineering – Gary L. Borman, Kenneth W. Ragland, McGraw Hill
2. Principles of Combustion – Kenneth K. Kuo, John Wiley & Sons
3. Fuels & Combustion – S. P. Sharma & Chander Mohan, Tata McGraw Hill
4. Fuels & Combustion - Sarkar

## **Elective I    iv) Vehicle Instrumentation & Testing**

Teaching scheme :

Lectures: 3 hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Planning & Measurement: Instrumentation – Selection of measuring instrument, requirements of measurement such as precision, accuracy, errors, sensitivity, readability and reliability.

Measurement of thermo physical properties: Devices to measure temperature and pressure of the working fluid, coolant, air and fuel flow into the engine.

Indicating and recording instruments: Vibrometer, Accelerometer, vibration and pressure pick ups, vibration test methods, Counters, stroboscopes, charge amplifiers, cathode ray oscillographs. FFT analyzer

Data acquisition and processing: General data acquisition system examples, storage, processing, recording and display devices

Factors affecting engine and vehicle performance and their fuel consumption

ISI codes for testing automotive engines, Laboratory dynamometer testing systems of power train and vehicle under simulated conditions, Test tracks – Instrumentation for testing vehicles – for performance and endurance trails.

Warning and alarm instruments : Brake actuation warning system, traficators, flash system, oil pressure warning system, engine over heat warning system, air pressure warning system, speed warning system, door lock indicators, gear neutral indicator, horn design, permanent magnet horn, air & music horns.

Dash board amenities : Car radio and stereo, courtesy lamp, time piece, cigar lamp, car fan, wind shield wiper, window washer, instrument wiring system and electromagnetic interference suppression, wiring circuits for instruments, electronic instruments, dash board illumination.

### **Term Work :**

Assignments / seminars based on advanced topics.

### **Reference Books:**

1. Engineering Experimentation – Ernest O. Doebelin
2. Experimental Methods for Engineers – Holman J.P., McGraw Hill Book Co.
3. Measurement Systems, Applications & Design – Ernest O Doebelin, McGraw Hill Book Co.
4. Modern Electric Equipments for Automobiles – Judge A. W., Chapman Hall, London
5. Applied Instrumentation in Process Industries – Andrews W. G.

**M.E. (Automobile) Semester – I****Elective I v) Automobile Air Conditioning**

Teaching scheme :

Lectures: 3 hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Refrigeration : Introduction, methods of refrigeration, vapour compression refrigeration system, vapour absorption refrigeration system, applications of refrigeration & air conditioning, Automobile air conditioning, air conditioning for passengers, isolated vehicles, transport vehicles, applications related with very low temperatures

Refrigerant : Classification, properties, selection criteria, commonly used refrigerants, alternative refrigerants, eco-friendly refrigerants, applications of refrigerants, refrigerants used in automobile air conditioning

Air Conditioning Systems: Classification, layouts, central / 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

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,

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

Air Routine & Temperature Control : Objectives - evaporator care air glow, through the dash recirculating unit, automatic temperature control, controlling flow, control of air handling systems.

Air Conditioning Service : Air conditioner maintenance & service - servicing heater system, removing & replacing components, trouble shooting of air conditioning system, compressor service, methods of dehydration, charging & testing.

Air Conditioning Control : Common control such as thermostats, humidistat, control dampers, pressure cutouts, relays.

**Term Work**

Assignments / seminar based on above topics

**Reference Books**

1. Heating & Air Conditioning Systems – Mitchell Information Services
2. Paul Lung, “Automotive Air Conditioning”, C.B.S. Publisher & Distributor, Delhi.
3. Harris, “Modern Air Conditioning”.
4. ASHRAE Handbook – 1985 Fundamentals
5. William H. Crouse & Donald L. Anglin, “Automotive Air Conditioning”, McGraw Hill, Inc., 1990.
6. Michel Information Services, Inc., Mitchell Automatic Heating & Air Conditioning Systems, Prentice Hall, Inc. 1989.
7. Paul Weisler, “Automotive Air Conditioning”, Reston Publishing Co. Inc. 1990

**M.E. (Automobile) Semester - I**

**SEMINAR - I**

Teaching scheme :

Practical: 2 hrs/ week/ student

Examination scheme :

Term work : 25 marks

Seminar-I should be based on the literature survey on any topic relevant to Automobile Engineering (should be helpful for selecting a probable title of dissertation).

Each student has to prepare a write up of about 25 pages of “A4” size sheets and submit it in duplicate as the term work.

The student has to deliver a seminar talk in front of the faculty members of the department and his classmates. The faculty members, based on the quality of the work and preparation and understanding of the candidate, shall do an assessment of the seminar internally – jointly.

Some marks should be reserved for the attendance of the student in the seminars of the others students.

## **1. Engine Design**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Determination of engine power, Engine selection, swept volume, stroke, bore & no. of cylinders, Arrangement of cylinders stroke to bore ratio.

Design procedure of theoretical analysis, design considerations, material selection & actual design of components - cylinder block design, cylinder head design, piston & piston pin design, piston ring design, connecting rod design, crankshaft design, flywheel design, design of valve mechanism

Engine balancing, firing order, longitudinal forces, transverse forces, pitching moments, yawing moments, Engine layout, major critical speed & minor critical speed, design of engine mounting, design of cooling system, design principles of exhaust & inlet systems,

Primary design calculation of major dimensions of fuel injection system

### **Term Work:**

Assignments based on design of major engine components (Assembly drawing) engine layout etc.

### **Reference Books**

1. I. C. Engine & Air Pollution – E. F. Obert, Harper & Row Publishers, New York
2. Engine Design – Giles J. G., Liffé Book Ltd.
3. Engine Design – Crouse, Tata McGraw Publication, Delhi
4. I.C. Engine by Maleev V. L., McGraw Hill Book, Co.
5. I. C. Engine – Litchy
6. SAE Handbooks

**M.E. (Automobile) Semester - II**

**2. Chassis & Body Engineering**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Vehicle Aerodynamics : Objects- vehicle drag and types, various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, principle of wind tunnel technology, flow visualization techniques, tests with scale models.

Car Body Details : Types of car bodies, visibility, regulations, driver's visibility, methods of improving visibility, safety design, constructional details of roof, under floor, bonnet, boot, wings etc, Classification of coach work,

Design of Vehicle Bodies: Vehicle body materials, Layout of the design, preliminary design, safety, Idealized structure- structural surface, shear panel method, symmetric and asymmetrical vertical loads in car, longitudinal loads, different loading situations- load distribution on vehicle structure, Calculation of loading cases, stress analysis of bus body structure under bending and torsion, stress analysis in integral bus body, Design of chassis frame, Rules and regulations for body, Recent safety measures, Testing of body.

**Term Work :**

Assignments / seminars based on advanced topics.

**Reference Books**

1. Vehicle Body Engineering – Pawloski J., Business Books Ltd.
2. The Automotive Chassis : Engineering Principles – Reimpell J.
3. Vehicle Body Layout and Analysis – John Fenton, Mechanical Engg. Publications Ltd. London
4. Body Construction and Design – Giles J. G., Illife Books, Butterworth and Co.

### **3. Vehicle Dynamics**

Teaching scheme :

Lectures: 4hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Suspension system - requirements, types, air suspension, rubber suspension, Shock absorbers, design of leaf spring, coil spring and torsion bar, types of drives-Hotchkiss and torque tube, wheel alignments, wheel wobble, wheel shimmy, pitching, bouncing and rolling, roll centre and roll axis, anti-roll bar, road holding,

Handling Characteristics: Steering geometry, Fundamental condition for true Rolling, Ackerman's Steering Gear, Davis Steering gear, Steady state Handling - Neutral steer, Under steer and over steer, Steady state response, Yaw velocity, Lateral Acceleration, Curvature response & Directional stability, jack-knifing in articulated vehicle, loading of automobile chassis due to road irregularities, comfort criteria, load transferred while braking and cornering, equivalent wt.of vehicle.

Ride Characteristics: Human response to vibrations, Single degree & Two degree freedom, Free & Forced vibrations, Vehicle Ride Model, Two degree freedom model for sprung & unsprung mass, Two degree freedom model for pitch & bounce, Vibrations due to road roughness and engine unbalance, Transmissibility of engine mounting, Motion of vehicle on undulating road & Compensated suspension systems.

#### **Term Work :**

Assignments / seminars based on advanced topics.

#### **Reference Books**

1. Theory of Ground Vehicles - J. Y. Wong - John Willey & Sons, NY
2. Steering, Suspension & Tyres – J. G. Giles, Iliffe Books Ltd., London
3. Mechanics of Road Vehicles – W. Stead, Iliffe Books Ltd. London
4. Automotive Chassis – P. M. Heldt, Chilton Co. NK

**M.E. (Automobile) Semester - II****4. Noise & Vibration**

Teaching scheme :

Lectures: 4hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Noise : Noise characteristics, Sources of noise, noise level measurement techniques, vehicular noise level, engine noise, transmission noise, brake squeal, structural noise, noise in auxiliaries, wind noises etc.

Noise Testing & Noise Control : Mechanization of noise generation, noise control methodologies, noise control measures, environmental noise management.

Road vehicle noise standards

Vibration: Introduction, Single degree of freedom, damped, forced vibration, Multi degree of freedom vibration, modes, nodes, Holzer's method.

Multi degree of freedom of vibration, matrix method, eigen values and vectors, natural frequencies & modes, modal analysis, numerical methods for solution, Lagrange's equation for problem formulation, Two degree of freedom system, co-ordinate, coupling, solution

Vibration under periodic force, use of Fourier series

Vibration of continuous systems, transverse vibration of cable, bar, torsion vibration of shaft, Rayleigh's method, Rayleigh-Ritz method

Vibration control, Balancing of reciprocating & rotating masses, controlling natural frequencies, vibration isolation, vibration absorbers.

Basics of non-linear vibration, causes of non-linearity, formulation, solution methods, iterative, graphical, methods of isoclines, stability of equilibrium state, types of singularity, limits cycle.

Basic vibration measuring set up, brief introduction to experimental modal analysis.

**Term Work :**

Assignments / seminars based on advanced topics.

**Reference Books**

1. Mechanical Vibration – S. S. Rao, New Age International (P) Ltd., New Delhi
2. Engineering Mechanics Static & Dynamics – I. H. Shames
3. Mechanical Vibration Analysis, P. Srinivasan, Tata McGraw Hill Pub. New Delhi
4. Non-linear Mechanical Vibration – P. Srinivasan, Tata McGraw Hill Pub. New Delhi
5. Fundamental of Mechanical Vibration – S. Graham Kelly, Tata McGraw Hill Pub.
6. Mechanical Vibration – Grover G. K., Nem Chand & Brothers, Roorkee
7. Engineering Vibration – Daniel J. Inman, Prentice Hall, NJ
8. Theory of Vibrations – W. T. Thomson, CBS Publishers, New Delhi
9. Noise, Pollution & Control – S. P. Singal, Narosa Publishing House, New Delhi



**M.E. (Automobile) Semester – II**  
**Elective II i) Computational Fluid Dynamics**

Teaching scheme :  
Lectures: 3hrs/week  
Practical: 1hrs/week

Examination scheme :  
Theory paper: 100 marks (3 hrs duration)  
Term work : 25 marks

Philosophy of computational fluid mechanics: Introduction, impact of CFD, application areas.

Governing equations of fluid dynamics: Introduction, models of the flow, substantial derivative of moving fluid element, divergence of the velocity, continuity equation, momentum equation, energy equation, physical boundary conditions

Mathematical behavior of PDE, the impact of CFD : Suitable forms of governing equations, hyperbolic, parabolic, elliptic equations, well posed problems

CFD techniques-

- a) Introduction – Lax – Wendroff technique, MacCormack's techniques, relaxation technique, numerical dissipation and dispersion, Alternating direction-implicit technique, pressure correction technique, need for the staggered grid, pressure correction formula, boundary condition for pressure correction method, introduction to different plots of computer graphics.
- b) Numerical solution for quasi one dimensional nozzle flow, subsonic, supersonic, isentropic flow and its CFD solution, shock capturing.

Fluid Mechanics problems in I.C. Engines : Flow through manifolds (single and multi cylinder engines), valves and ports, elements of air motion in engines viz. Swirl, squish, tumble and turbulence. Basics of turbulent flow – turbulence modeling and characterization of turbulent mixing.

Outline of fluid dynamic models –applications of available commercial codes to engine processes with and without chemical reactions

**Term Work :**

Problems using CFD based software.

**Reference Books**

1. John D. Anderson, "Computational Fluid Dynamics: The Basics with application", McGraw Hill, New Delhi.
2. W. Kutzner, Fluids Mechanics
3. Streeter, "Fluid Mechanics", Tata McGraw Hill, New Delhi
4. Computational Fluid Flow & Heat Transfer – K. Muralidhar, T. Sundarajan, Narosa Pub. House, New Delhi

**M.E. (Automobile) Semester – II**  
**Elective II ii) Human Resource Development**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Overview of Human Resource Management: Evolution of Human Resource management from commodity approach to systems approach. Activity of Human Resource management-perspective and challenges.

Role of Human Resource Management: Human Resource management of work, Changing environment & Human Resource management, Objectives and importance of HRM,IRM to-day and tomorrow

Human Resource Planning: Human Resource Planning on Macro level Human Resource Planning in India challenges and possible solutions, Human Resource Demand Forecasting Supply forecasting, repairing actions plan.

Human Resource Planning at Micro Level: Job Analysis- uses of job Analysis: Methods and Process of Job Analysis, Job description and Job Specification, Examples and exercise.

Procurement of Human Resource: Recruitment- Meaning and Process formulating recruitment policy, Evaluation of Recruitment sources, modern Techniques of recruitment sources – internet based, placement agencies.

Selection of Human Resource : meaning and process, selection Hurdles – application Blank, Employment test – utility & validity, employment interviews, principles & techniques, medical text, referenced check appointment – terms & conditions

Training for development : Concept of training & development, steps in training & development, training process – identification of training needs, sources of information, designing the programme, methods of training usage, advantages & disadvantages, evaluation of training, evaluation of procedure.

Performance appraisal : Definition, objectives, essential of performance appraisals & problems of performance appraisal, process of performance appraisal – self assessment & its important, methods of performance appraisal – traditional & modern methods – straight ranking method, peer comparison method, critical incident method, behavioral, anchored rating scale.

**Term Work :**

Six assignments based on above syllabus.

**Reference Books :**

1. Managing Technical People – Humphrey – Pearson
2. Management of Organizational Behavior Leading Human Resources – Hersey
3. Strategic Human Resource Management – Greer
4. Managing Human Resources – Gomez – Mejia
5. A Framework for Human Resource Management – Dessler

**M.E. (Automobile) Semester – II**

**Elective II    iii) Advanced Automotive Electronics**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hrs/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Fundamentals of Automotive Electronics : Microprocessor and micro computer applications in automobiles – Components for engine management system – electronic management of chassis system, vehicle motion control, electronic panel meters

Sensors & Actuators : Introduction, basic sensor arrangement, types of sensors, oxygen sensor-cranking sensor – position sensors – engine cooling water temperature sensors, engine oil pressure sensor, fuel metering, vehicle speed sensor & detonation sensor, stepper motors – relays.

Electronic fuel injection & ignition system : Introduction, feedback carburetor system, throttle body injection and multi point fuel injection system, injection system controls, advantage of electronic ignition systems, types of solid state ignition system and their principles of operation, electronic spark timing control.

Digital engine control system : Open loop and close loop control system, engine cooling and warm up control, Acceleration, detonation and idle speed control-integrated engine system, exhaust emission control engineering, on-board diagnostics, diagnostics, future automotive electronic systems,

Automotive Electrical: Batteries, starter motor & drive mechanism, d.c. generator & alternator, regulation for charging, lighting design, dash board instruments, horn, warning systems and safety devices.

Comfort and safety : seats, mirrors and sun-roofs, central locking and electronic windows, cruise control, in-car multimedia, security, airbag and belt tensioners, other safety and comfort systems, advanced comfort and safety systems, New developments in comfort and safety

The system approach to control & instrumentation, Electronics fundamentals, Electronic components and circuits, digital electronics, microcomputer instrumentation and control, sensors and actuators, digital engine control systems, vehicle motion control, automotive instrumentation and telematics, new developments,

**Term Work :**

Assignments / seminars based on advanced topics

**Reference Books**

1. Automobile Electrical & Electronic Equipments - Young, Griffiths - Butterworths, London
2. Understanding Automotive Electronics – Bechfold SAE 1998
3. Fundamentals of Automotive Electronics - V.A.W.Hilliers - Hatchin, London
4. Automotive Computer & Control System – Tomwather J. R., Cland Hunter, Prentice Inc. NJ
5. Automotive Computers & Digital Instrumentation – Robert N. Brandy, Prentice Hall Eaglewood, Cliffs, NJ
6. The Fundamentals of Electrical Systems - John Hartly - Longman Scientific & Technical
7. Understanding Automotive Electronics – William B. Ribbens, Allied Publishers Pvt. Ltd., Chennai.
8. Automobile Electrical & Electronic Systems – Tom Denton, Allied Publishers Pvt. Ltd., Chennai.

**M.E. (Automobile) Semester – II****Elective II iv) Automotive Maintenance & Management**

Teaching scheme :

Lectures: 3hrs/week

Practical: 1hr/week

Examination scheme :

Theory paper: 100 marks (3 hrs duration)

Term work : 25 marks

Maintenance records and schedule: Importance of maintenance with different types, maintenance records, factors considered for design & development of modern service garages / dealers shops, different garage layouts.

Engine Maintenance: Engine troubles, effects & remedies, different major & minor services for engine, inspection and checking of components visually and dimensionally, reconditioning methods of engine components, engine tune-up, special tools & advanced equipments.

Chassis Dive-line Maintenance: Maintenance, repair and servicing of clutches, Fluid flywheel, gear boxes, Automatic transmission ,CVT unit, propeller shaft, differential unit, front axle and rear axle, suspension systems, servicing of brake systems- hydraulic, air systems, brake bleeding and brakes adjustments, maintenance and servicing of steering system-Manual & Power Steering system, wheel balancing, wheel alignment, maintenance of tyres, tyre rotation, frame defects, chassis frame alignment.

Maintenance, servicing of auxiliaries: Cooling system service, anti corrosion additives, anti freezing solutions, dry & wet liners, Petrol fuel and diesel fuel system maintenance, MPFI maintenance, lubrication system services, Chassis lubrication, lubrication chart, maintenance and care of storage batteries, battery testing methods, maintenance of ignition systems, tyre service & reconditioning.

Maintenance & repair of vehicle body: Passenger comfort parameters, body coach work, window rattling, noise & vibration, body repair tools & equipments, polishing and painting of new and old vehicle body

**Term Work :**

Assignments / seminars based on advanced topics.

**Reference Books**

1. Mechanics of Road Vehicles – W. Steed, Illefe Books Ltd. London
2. Automotive Chassis – P. M. Heldt, Chilton Co. NK
3. I. C. Engine – Litchy
4. I. C. Engine – Obert
5. Introduction to Internal Combustion Engines”, Richard Stone, McMillan, London
6. Vehicle and Engine Technology – Hein Heister
7. Advance Vehicle Technology - Hein Heister
8. S. I. Engine – Fuel Injection Development - Charles A. Fisher, Chapman & Hall
9. Automotive Engines - Herbert E. Ellinger
10. Automobile Engg. Volume – I - American Technical Society, Chicago
11. Internal Combustion Engines Fundamentals – John B. Heyhood, McGraw Hill

**M.E. (Automobile) Semester – II**  
**Elective II v) Tribology**

Teaching scheme :  
 Lectures: 3hrs/week  
 Practical: 1hrs/week

Examination scheme :  
 Theory paper: 100 marks (3 hrs duration)  
 Term work : 25 marks

Introduction: Introduction of Tribology – General tribological considerations in the design of bearings, gears, cams, reciprocating components, etc.

Engine tribology basics, - tribology / aspects of engine components such as bearings, piston assembly, valve train and drive train components etc.

Friction: Nature of metal surfaces – Surface properties – Surface parameters and measurements. Friction – Sliding friction – Rolling friction characteristics of common metals and non-metals – friction under environments. Engine friction – Losses and engine design parameters.

Wear: Economic role of wear – type of wear- wear mechanism, factors affecting wear, selection of materials for different wear situations, measurement of wear, tribometers and tribometry. Engine wear, mechanisms, wear resistance material and coatings and failure mode analysis.

Bearings and Lubrication : Lubricants, type of lubricants, properties and testing, service classification of lubricants, lubrication of tribological components, lubrication system, lubricant monitoring, SOAP, ferrography and other rapid testing methods for lubricants contamination.

Hydrodynamic Lubrication: Theory of hydrodynamic lubrication, generalized Reynolds equation, slider bearings, fixed & pivoted shoe bearings, hydrodynamic journal bearings, short and finite bearings, thrust bearings, sintered bearing, non-circular bearings and multi side surface bearings.

Externally (Externally – pressurized) lubrication: Hydrostatic bearing, basic concepts, bearing pads, coefficients, restrictors, capillary, orifice and flow control valve, bearing characteristics number and performance coefficients, flat, conical and spherical pad thrust bearing, multi-recess journal and thrust bearings, air and gas lubricated bearings.

Elasto – hydrodynamic lubrication : Ball and roller element bearings, classification, selection and life estimation, fatigue, monitoring of ball / roller bearings, diagnostics.

Rheodynamics (Static ) lubrication: Non-Newtonian fluids, characteristics, general recommendations of lubricants, SAE & other cloud numbers, thixotropic, materials and Bingham solids, grease lubrication and care stability, tribology components in extreme environments like vacuum, pressure, temperature, tribology matching and selection, tribology-testing and standards.

**Term Work :**

Assignments / seminars based on advanced topics.

**Reference Books**

1. Friction and Lubrication, Bowden F.P. & Tabor D., Heinemann Edu. Books Ltd. 1974
2. Friction & Wear of Material, Ernest Rabinowicz
3. Tribology – Handbook, Neal M.J., Butterworth, 1973
4. Standard hand Book of Lubrication Engg., O'Connor J.J. & Boyd J., McGraw Hill, 1968.
5. Theory of Hydro-dynamic Lubrication, Pinkus O, & Sternlicht B., McGraw Hill, 1961.
6. Theory & Practice of Lubrication of Bearing, Fuller D.D., McGraw Hill, 1947.
7. Analysis & Lubrication of Bearings, Shaw M. C., Macks F., McGraw Hill, 1947
8. Analysis & Lubrication of Bearings for Machine Tools and Similar Applications, Stansfield F., Machinery Publishing, 1970
9. Tribology, B. C. Muzumdar

**M.E. (Automobile) Semester - II**

**Seminar - II**

Teaching scheme :

Practical: 2 hrs/ week / student

Examination scheme :

Term work : 25 marks

Seminar - II shall be based on tentative topic on dissertation such as review paper on some specific well defined area/specialized stream of automobile engineering

Each student has to prepare a write up of about 25 pages of “A4” size sheets and submit it in duplicate as the term work.

The student has to deliver a seminar talk in front of the faculty members of the department and his classmates. The faculty members, based on the quality of the work and preparation and understanding of the candidate, shall do an assessment of the seminar internally – jointly.

Some marks should be reserved for the attendance of the student in the seminars of the others students.

**Industrial Training**

The student has to undergo Industrial training of at least Three to Four weeks in the vacation after semester II. The college / department shall take necessary steps for placing the students in the industries engaged in the area of specialization.

**M.E. (Automobile) Semester - III**

**1. Industrial Training Report**

Examination scheme :

Term work : 50 marks

The student has to prepare the report of the training undergone in the industry during vacation after semester – II. It shall include the brief details of assignments completed by the candidate and general observations and analysis.

The identified areas for undertaking the dissertation work shall form part of report. A term work marks be based on report and departmental oral examination.

**M.E. (Automobile) Semester - III**

**2. Seminar - III**

Teaching scheme :

Practical: 1 hrs/ week/student

Examination scheme :

Term work : 50 marks

Seminar – III shall be based on the work carried out for dissertation. This may cover the point right from various areas considered and analysis, the relevance feasibility and scope of work for finally selected topic, alternative solution and appropriate solution.

Each student has to prepare a write up of about 25 pages of “A4” size sheets and submit it in duplicate as the term work.

The student has to deliver a seminar talk in front of the faculty members of the department and his classmates. The faculty members of the department shall do an assessment, based on the quality of the work and preparation and understanding of the candidate. Some marks should be reserved for the attendance of the student in the seminars of the others students.

**M.E. (Automobile) Semester - III**

**3. Dissertation – Phase I**

Teaching scheme :

Practical: 4 hrs/ week/student

Examination scheme :

Term work : 50 marks

The term work under this, submitted by the student shall include –

1. Work diary maintained by the student and counter signed by his guide.
2. The contents of work diary shall reflect the efforts taken by candidate for
  - (a) Searching the suitable project work
  - (b) Visits to different factories or organizations
  - (c) Brief report of journals and various papers referred
  - (d) Brief report of web sites seen for project work
  - (e) The brief of feasibility studies carried to come to final conclusion
  - (f) Rough sketches
  - (g) Design calculation etc. etc. carried by the student.

The student has to make a presentation in front of panel of experts in addition to guide as decided by department head.

**M.E. (Automobile) Semester - IV**

**1. Dissertation**

Teaching scheme :

Practical: 5 hrs/ week/student

Examination scheme :

Term work : 100 marks

Oral : 200 marks

The dissertation submitted by the student on topic already approved by university authorities on the basis of initial synopsis submitted by the candidate shall be according to following guidelines –

Format of dissertation report –

The dissertation work report shall be typed with double space on A4 bond paper. The total number of pages shall not be more than 150 and not less than 60. Figures, graphs, annexures etc. be added as per requirement. The report should be written in the following format.

1. Title sheet
2. Certificate
3. Acknowledgement
4. List of figures / photographs / graphs / tables
5. Abbreviations
6. Abstract / final synopsis
7. Contents
8. Text with usual scheme of chapters
9. Discussion of the results and conclusion
10. Bibliography (The source of illustrative matter be acknowledged clearly at appropriate place)

SAWANT SP

BIRJE SR/JC

K:\eback\newsyllabus\engineering\M.E\M.E.(Auto) New\ME auto draft syllabus.doc/ birje