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SHIVAJI UNIVERSITY, KOLHAPUR.

Revised Syllabus of

(B.E. Automobile Engineering Sem –VII & VIII)

To be introduced from the academic year 2010-11
(i.e. from June 2010) Onwards

(Subject to the modifications will be made from time to time)

Shivaji University, Kolhapur

Syllabus Structure of Final Year (B. E. Auto.-I) Automobile Engineering Course

Scheme of Teaching and Examination

SEMESTER – VII

Sr. No.	Name of the Subject	Teaching Scheme (Hrs)			Examination Scheme (Marks)			
		L	T	P	Theory	TW	Pract./ Oral	Total
1	Engine & Machine Design	4	--	4	100	25	25	150
2	Vehicle Dynamics	3	--	--	100	--	--	100
3	Finite Element Analysis	3	--	2	100	25	--	125
4	Alternative Fuels & Emission	3	--	2	100	25	25	150
5	Electives – I	3	--	2	100	25	--	125
6	Industrial Case Study Evaluation	--	--	2*	--	25	--	25
7	Engine Testing	--	--	2	--	25	50	75
	Project Phase I	--	--	2*	--	50	--	50
		16	--	14	500	200	100	800
Total Contact Hours per week				**30**	Total Marks			**800**
* Combine utilization for project phase I and industrial case study evaluation								

Sr. No.	Electives – I
1	Noise and Vibration
2	Energy Engineering
3	Computer Integrated Manufacturing Systems
4	Industrial Product Design
5	Production Management

Shivaji University, Kolhapur

Syllabus Structure of Final Year (B. E. Auto.-II) Automobile Engineering Course

Scheme of Teaching and Examination

SEMESTER – VIII

Sr. No.	Name of the Subject	Teaching Scheme (Hrs)			Examination Scheme (Marks)			
		L	T	P	Theory	TW	Pract./ Oral	Total
1	Refrigeration & Air Conditioning	3	--	2	100	25	--	125
2	Automotive Electronics	3	--	2	100	25	--	125
3	Automotive System Design	3	--	4	100	25	25	150
4	Vehicle Performance	3	--	2	100	25	25	150
5	Elective – II	3	--	--	100	--	--	100
6	Project	--	--	5	--	75	75	150
		15	--	15	500	175	125	800
Total Contact Hours per week				**30**	Total Marks			**800**

Sr. No.	Elective- II
1	Transport Management
2	Entrepreneurship Development
3	Tractor and Farm Equipment
4	Maintenance Management
5	Operation Research

[Note :- Examination scheme and term work marks strictly as per above structure]

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B. E. (Automobile)

1. ENGINE & MACHINE DESIGN

Teaching scheme:
Lectures: 04 hrs. /week
Practical: 04 hrs. /week

Examination scheme:
Theory paper : 100 marks (3 hrs. duration)
Term Work : 25 Marks
Practical Oral : 25 Marks

SECTION – I

1. Design for Fluctuating Loads:
Fluctuating stresses, S-N diagram for fatigue loading, Endurance limit, Endurance strength modifying factors, Stress concentration-causes and remedies, Notch sensitivity, Design for finite and infinite life under reverse stresses, Cumulative damage in fatigue failures, Soderberg and Goodman diagrams, Modified Goodman diagram 08

2. Engine Functional Design:
Selection of engine type, Stroke & Bore, No. of cylinders, cylinder arrangement, Design considerations for Combustion chamber, engine balancing, Selection of firing order and cooling system. 08

3. Engine Component Design:
Design of Piston, Piston pin, Connecting Rod, Crankshaft, Cylinder liner, cylinder head, Flywheel. 16

SECTION – II

4. Design of valve gear train:
Design of Valve, rocker arm, Push rod, cam shaft, cam and follower 07

5. Design of cooling & lubrication system:
Design of radiator, water pump, selection of lubricating oil and pump 06

6. Sliding Contact Bearings:
Bearing materials and their properties, Bearing types and constructional details, Hydrodynamic theory of lubrication, Raimondi and Boyd method, Design of bearings, bearing performance parameters. 06

7. Rolling Contact Bearing:
Types of rolling contact bearings, static and dynamic load, Stribeck's Equation, Equivalent bearing load, load life relationship, capacities, Bearing life, Load factor, Selection of bearings from manufacturers catalogue, Lubrication and mountings, dismounting and preloading of bearings. 05

Term Work:

- Assembly & Detail drawing of existing engine by actual measurements 06
- Demonstration on stress concentration by photo elasticity 01
- Experiment on Journal bearing 01
- Design of engine components 08
- Detail drawing of components sheet of A1 size 08
- Engine assembly drawing sheet of A1 size 04

Books Recommended:

1. S. P. Patil, Mechanical System Design, Jaico Publications,
2. V. L. Maleev, I. C. Engine, McGraw Hill Book Co. Ltd., New Delhi, Second Edition
3. Gill P. W., Smith J. H., Zurich E. J., Fundamentals of I. C. Engine, Oxford & IBH Pub. Co., New Delhi.
4. E. F. Obert, I.C. Engine & Air Pollution , Harper & Row Publishers, New York
5. Heywood J.B.,I. C. Engine Fundamentals, Mc Graw Hill Book Co., New Delhi
6. Litchy, I. C. Engine, McGraw Hill
7. Bhandari V. B., Design of Machine Elements, Second Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi
8. Joseph E. Shigley & Larry D. Mitchell, Mechanical Engineering Design, Sixth Edition, McGraw-Hill International Book Company
9. M.F. Spotts & T.E. Shoup, Design of Machine Elements, Seventh Edition, Pearson Education
10. George E. Dieter, Engineering Design- A Material and Processing Approach, Second Edition, McGraw-Hill International Edition
11. Robert C. Junivall, Fundamentals of Machine Component Design, John Wiley & Sons
12. Paul H. Black & O. Eugene Adams Jr., 'Machine Design', Third Edition, McGraw-Hill International Edition
13. P. Kannaih, Machine Design, Scitech Publications (I) Pvt. Ltd., Second Edition
14. A.Kolchin and V.Demidov, Design of Automotive Engines, Mir Publishers, Moscow, 1984.
15. Gordon P.Blair, Design and Simulation of Four-Stroke Engines, Society of Automotive Engineers, Inc., USA, 1999.
16. D.E. Winterbone and R.J.Pearson, Design Techniques for Engine Manifolds, Wave action methods for I.C. Engines, Professinal Engineering Publishing Ltd., UK, 2000.
17. Bearing Manufacturers' catalogues
18. Design Data Book.

B. E. (Automobile)

2. VEHICLE DYNAMICS

Teaching scheme:
Lectures: 3 hrs/week

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

SECTION – I

1. **Introduction:**
   Introduction to vehicle dynamics, Vehicle coordinate system, Earth fixed coordinate system, Longitudinal, lateral and vertical vehicle dynamics, vehicle springing system - requirements, sprung mass and unsprung mass. 03

2. **Performance Characteristics of Road Vehicles**
   a. **Steady State Operation :** Various external forces acting on vehicle, Nature of the forces and factors affecting the forces, Tractive effort & Power available from the engine, Equation of motion, Maximum tractive effort, Weight distribution, Stability of vehicle on slope, Road performance curves, Acceleration, Gradibility & Drawbar Pull. 06

   b. **Transient Operation :** Inertia effect, Equivalent mass, Equivalent moment of inertia, Equivalent ungeared system, Time to produce synchronizing during gear change, Effect of engine flywheel on acceleration, Dynamics of vehicles on Banked tracks, Gyroscopic Effects, Net driving power. 06

3. **Braking Characteristics** : Braking of vehicle - Braking applied to rear wheels, Front wheels and all four wheels, On straight & Curved path, Mass transfer & its effect, Braking efficiency & stopping distance, Reaction time & stopping time, Calculation of mean lining pressure & heat generation during braking. 06

SECTION – II

4. **Handling Characteristics**: Pitching, bouncing, yawing & rolling, wheel wobbling, Steering geometry, Fundamental condition for true Rolling.

   Steady State Handling: Slip angle, cornering power, Neutral steer, Under steer and over steer, Steady state response, Yaw velocity, Lateral Acceleration, Curvature response & Directional stability.

   Transient Handling: Basic principles, differential equations of motions.

   Vehicle Test for handling performance: Steady state testing, constant speed test, constant steer angle test. Constant radius test. 10

5. **Ride Characteristics** :

   Vibrations due to road roughness, vehicle ride model, Human response to vibrations, Two degree freedom model for sprung & unsprung mass, Two degree freedom model for pitch & bounce, Motion of vehicle on undulating road & Compensated suspension systems, roll centre & roll axis. Introduction to random vibrations, Evaluation of vehicle, vibration in relation to ride comfort criterion.

   11

References

1. J. Y. Wong, “Theory of Ground Vehicles”, John Willey & Sons, NY
2. J. G. Giles, “Steering, Suspension & Tyres”, llefe Books Ltd., London
3. W. Steed, “Mechanics of Road Vehicles”, llefe Books Ltd. London
4. P. M. Heldt, “Automotive Chassis”, Chilton Co. NK
5. N. K. Giri, “Automobile Mechanics”.
6. Thomas D. Gillespie, “Fundamentals of vehicle dynamics”, Published by SAE Inc.
7. Rajamani, “Vehicle dynamics”,

B. E. (Automobile)

3. FINITE ELEMENT ANALYSIS

Teaching scheme:	**Examination scheme:**
Theory: 3 Hrs/Week	Theory: 100 Marks (3 hrs. duration)
Practical: 2 Hrs/Week	Term work: 25Marks

SECTION- I

1. Introduction to FEM

Mathematical models, Numerical simulation, Different numerical methods- FEM, FDM, BEM and FVM. Basic idea of FEA, Comparison with analytical and experimental methods, past, present and future of FEA, Advantages and applications of FEA, Steps in FEA. 04

2. Direct Stiffness Method

Degrees of freedom, Stiffness matrix, linear spring element, Assembly of global system of equations, Elastic bar element, thermal rod and torsion of circular shaft. 03

3. Meshing

Need of meshing, Types of elements-1D,2D,3D and other, Element shapes and interconnections, Element selection, use of symmetry in meshing, Selection of Element Type & Size, node numbering, element numbering, mesh quality checks, mesh density, meshing of critical regions, special elements and techniques of meshing. Rules of meshing. Modeling of joints, Material properties and boundary conditions. Physical behavior vs. element behavior, mesh design and refinement. 06

4. Interpolation Polynomial

Introduction, Displacement models, simplex, multiplex and complex elements, selection of interpolation polynomial, shape functions for simplex elements, Natural coordinates. 05

5. Formulation of element characteristic matrix

Variational approach, principle of stationary potential energy, Rayleigh –Ritz method. Weighted Residual method, Galerikin method. 04

SECTION-II

6. Structural Analysis

Basic concepts of Elasticity, variational method for 1D and 2D elasticity, * Nonlinear structural analysis (*no numerical treatment), Comparison of Linear and Non Linear Analysis 05

7. Thermal Analysis

Formulation of FE method for heat conduction, Galerikin's method for heat conduction equation, 1D & 2D heat conduction. *Transient heat conduction (*no numerical treatment) 04

8. Dynamic analysis

Introduction, Simple harmonic oscillator, Multi degree freedom system, axial vibration of rod-consistent mass matrix, *Modal analysis, Eigen value problems, fatigue analysis, Buckling analysis. (*no numerical treatment) 04

9. Higher order and Isoparametric elements

Higher order 1D and 2D elements, classical interpolation polynomials, Isoparametric elements – coordinate transformation and mapping, stiffness matrix for isoparametric elements, Numerical integration. 04

10. Result Interpretation & Verification of FEA results

Sources of error, Discretization error, mesh refinement, model validity and accuracy. Sub structuring technique, Thumb rules for viewing the results, Nodal, Elemental, Average, Un average stresses, Post processing techniques. 03

TERM WORK

Minimum 10 experiments should be performed using any analysis software.

1. Rod element subjected to tension & comparison with analytical answer
2. Cantilever Beam element exercise and comparison with analytical answer
3. Plane Stress analysis of Bracket/ Plate
4. Static structural analysis of Allen Wrench
5. Demonstration of thermal analysis
6. Steady state thermal analysis cylinder
7. Thermal analysis of composite wall
8. Thermal analysis of turbine blade
9. Linear buckling analysis of column.
10. Dynamic analysis of dropping an aluminum container on a steel table top.
11. Harmonic analysis of spring mass system.
12. Contact analysis of pinhole with pin
13. Non linear analysis of plate subjected cyclic load.
14. Transient thermal analysis of a casting process.

References Books:

1. Concepts and applications of FEA, Robert D. Cook, David S. Malkus, John willy & sons, inc.
2. The Finite Element Method in Engineering, Singiresu S. Rao, Butterworth Heinemann publications.
3. Finite Element Analysis theory and programming, C. S. Krishnamurthy, Tata McGraw Hill Publishing company Ltd. Delhi.
4. Practical FEA, Nitin S. Gokhale, Finite to Infinite, Pune.
5. Fundamentals of FEA, David V. Hutton, Tata McGraw Hill Publishing company Ltd. Delhi.

6. The FEA and applications in engineering using ANSYS, Erdogan Madenci, Ibrahim Guven, Springer.
7. The FEA theory and applications with ANSYS, Saeed Moaveni, Prentice Hall, New Jersey.
8. Introduction to Finite elements in engineering, Tirupati R. Chandrupatla, Ashok D. Belegundu, Prentice Hall of India, New Delhi.
9. Finite Element Analysis, Bhavi Katti,
10. Finite Element Analysis by Dr. P. Seshu, Prentice Hall

4. ALTERNATIVE FUELS & EMISSION

Teaching scheme:
Lectures: 3hrs./week
Practical: 2hrs./week

Examination scheme:
Theory Paper: 100 marks (3 hrs. duration)
Term work : 25 marks
Oral : 25 marks

SECTION - I

1. Alternative Fuels & Their Sources

Sources of fuels – Bio fuels , Edible & non edible vegetable oils, hydrogen, LPG, CNG, Bio gas, Methanol & Ethanol, Engine modification required to use alternative fuels, Dual fuel engine, Fuel efficiency, fuel requirement, rating of fuels, Hybrid drives

05

2. Production methods and availability

Production methods, Availability, Economics, Engine performance and Emission Characteristics with alternative fuels, Limitations,

04

3. Hydrogen:

Properties of hydrogen with respect to its utilization as renewable forms of energy, sources of hydrogen, production, transportation, storage, application & economics of hydrogen**.** 03

4. Fuel cells

Principle, Types, Full cell for Automotive application (PEM), PEM fuel cell stack construction, performance 02

5. Engine Emissions

Automobile emission scenario, Sources of emission from vehicle, Formation of pollutants, CO, NOx, UBHC, Soot & Particulate formation 02

6. SI engine Emission

Emissions from SI engine, Compression ratio, equivalence ratio, Ignition timing, Mixture preparation, Residual gas dilution, engine speed, coolant temperature, fuel injection and in cylinder liquid fuel during warm up 04

SECTION – II

7. CI engine Emission

Emissions from CI engine, Compression ratio, combustion chamber dead volumes, in cylinder air swirl, multi valves, fuel injection variables, engine load, engine speed. 03

8. Emission Measurement, Test procedures & regulations

Test cycles for light & medium duty vehicles, test procedure for evaporative emissions, Emission standards for light and heavy duty vehicles & motor cycle emission standard. NDIR analyzers, FID, Chemiluminescence NOx analyzer, oxygen analyzer, smoke measurement, constant volume sampling, particulate emission measurement, Orsat apparatus. 07

9. SI engine emission control technologies

Engine design parameters, add on systems for treatment of emissions with engine, thermal exhaust after treatment, catalytic exhaust after treatment, types of cat con. 06

10. CI engine emission control technologies

Fuel injection variables, electronic fuel injection system, EGR, turbo charging, catalytic exhaust gas after treatment, diesel particulate filters 06

Term work (Mini. Ten):

1. Study of Emission Norms
2. Measurement of emission by portable exhaust gas analyzer.
3. Measurement of emission by Infra Red Gas Analyzer (IRGA)
4. Measurement of smoke by Bosch smoke meter
5. Measurement of smoke by Hartridge smoke meter
6. Analysis of effect of Exhaust Gas Recirculation (EGR) on engine emission
7. Demonstration / Study of Evaporative Loss Control Device (ELCD)
8. Demonstration / Study of catalytic converter
9. Analysis of exhaust gas using Orsat Apparatus
10. Demonstration / Study of LPG Kit
11. Measurement of petrol engine emissions with the help of HC/CO analyzer
12. Study of Flame Ionization Detector.

Books Recommended:

1. B. P. Pundir, Engine Emissions, Narosa Publications
2. E.F. Oberts, “Internal Combustion Engine and Air Pollution”, Harper & Row Publisher, NY.
3. J.G. Giles, “Vehicle Operation & Testing” (Automotive Vehicle Technology Vol. 7)
4. C.H. Fisher, “Carburetion”, Vol. 4.
5. A.W. Judge, “Carburetion and Fuel Injection System”, Motor Manual, Vol. 2, The Caxton Pub. Co. Ltd., London.
6. H.H. Willard and Others, “Instrumental Method of Analysis”, CBS Publishers & Distributors, Delhi.

7. G.B.S. Narang, “Automobile Engineering”, CBS Publishers & Distributors, Delhi.
8. Gupta B. R., “Electronics & Instrumentation Handbook”, Wheeler Publishing.
9. F. Schafar & R van Basshuysen, “Reduced emission and fuel consumption in automobile engine”Springer-Verlag Wien New York.
10. John k Pearson,” Improving air quality”.
11. Richard L.Bechtold , “Alternative Fuels Guidebook”

B.E. (Automobile)

5. ELECTIVE – I NOISE & VIBRATION

Teaching scheme:
Lectures: 3 hrs./week
Practical: 2 hrs./week

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

SECTION - I

1. Introduction to Vibration:
Introduction, Causes and effects of vibration, vibration terminology, Equation of motion-Energy method, Rayleigh's method etc., Harmonic and periodic motions, Vibration standards, Single-DOF Free Vibrations **04**

2. Multi Degree of Freedom Vibrations:
Matrix formulation, eigen values and eigen formulation, matrix iteration techniques – normal modes and orthgonality, transient response of multi degree freedom system, mode superposition technique, torsional oscillations of multirotor systems **06**

3. Torsional vibrations:
Simple systems with one or two rotor masses Multi-DOF systems-transfer matrix method Geared system Branched system **04**

4. Vibration Instrumentation:
Vibration measurements – Vibration measurement parameters (displacement, velocity & acceleration),instrumentation –electrodynamics exciters – impact hammers, piezoelectric accelerometers, signal conditioning and amplification, filters, preamplifiers and power amplifiers, real time analysis, FFT analysis, structural frequency response measurement, modal testing of beams, Modal parameter (natural frequency, mode shape and damping) estimation techniques **07**

.

SECTION - II

5. Vibration analysis:
Relevance of vibration analysis, introduction to experimental modal analysis**,** Structural modal analysis, mode shapes, Euler's beam equation for natural frequency, Calculation of natural frequencies - Rayleigh method, Stodala method, machine diagnostics through vibration analysis. **07**

6. Noise:
Introduction, causes, effects, basic terms, Noise characteristics, Sources of noise, vehicular noise level, engine noise, transmission noise, brake squeal, structural noise, noise in auxiliaries, wind noises, wave equation, noise standards etc. **04**

7. Noise measurement:
Sound and Noise parameters, propagation of sound & noise in various machinery's, noise measuring parameters, noise level measurement techniques, Noise level interpolation and mapping, noise measuring instruments **05**

8. Noise Control:
Mechanization of noise generation, noise control methodologies, noise control measures, environmental noise management, Road vehicle noise standards, Sound absorption by porous materials, silencer and suppression systems, Sound absorption, sound insulation, acceptance noise levels **05**

Term Work (Mini. 10):

1. Demonstration vibration measuring instruments
2. Determination of natural frequency of simple components
3. Vibration measurement in driver's cabin
4. Noise measurement in driver's cabin
5. Experiment on Logarithmic decrement
6. Structural modal analysis of Plates using FEA
7. Structural modal analysis of pipes using FEA
8. Vibration measurement in Passengers compartment
9. Noise measurement in Passengers compartment
10. Engines Vibration measurement
11. Engines Noise measurement
12. Study of vibrations of static equipments
13. Study of vibrations of rotary equipments.
14. Study of machine diagnostics through vibration analysis.

Text Books:

1. N. L. Meirovitch, Elements of vibration Analysis, Mc Graw Hill New York, 1986.
2. J.P. Den Hartog, Mechanical Vibration, 4th edition, Mc Graw Hill, New York 1985.
3. Irwin & Garf, Industrial Noise & Vibration Control.
4. Mechanical Vibration – S. S. Rao, New Age International (P) Ltd., New Delhi
5. Mechanical Vibration Analysis, P. Srinivasan, Tata McGraw Hill Pub. New Delhi
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
10. A text book of sound, L.P. Sharma & H.C. Saxena
11. Engineering Noise Control, D.A. Bies & C.H. Hausen
12. Noise & Vibration Control, Leo N. Beraneck,

Reference Books:

1. Harris, C. M. Handbook of Acoustical Measurements and Noise Control, Acoustical Society of America, 1998.
2. Beranek L.L. & Ver I.L., Noise and Vibration Control Engineering: Principles and Applications, 2nd ed., Wiley 2006
3. Leonard Meirovitch, Fundamentals of Vibrations, Mc Graw Hill New York
1. 4 J.S. Rao and K. Gupta, Advanced theory of Vibration.Willey Eastern.1992.
2. 5 R.A. Collacott, Vibration Monitoring and diagnosis, John Willey, New York, 1979.
6. M. Petyt, Introduction to Finite Element Vibration Analysis, Cambridge University
7. Fundamentals of Mechanical Vibration – S. Graham Kelly, Tata McGraw Hill Pub.
8. Morse P.M., Vibration and Sound, Acoustical Society of America, 1981.

B.E. (Automobile)

5. ELECTIVE – I ENERGY ENGINEERING

Teaching Scheme :
Lecturers: 3 Hrs/ Week
Practical: 2 Hr./ Week

Examination Scheme :
Theory: 100 Marks (3 hrs. duration)
Term work: 25 Marks

SECTION - I

1. Introduction:

Fossil fuel based systems, Impact of fossil fuel based systems, World scenario of Energy Resources, Indian Scenario of Energy Resources - new and renewable energy – sources and features. **03**

2. Solar Thermal System:

Solar potential, Solar radiation spectrum, Solar radiation geometry, Solar radiation data, Radiation measurement, Technologies of thermal energy collection, Types of Solar Collectors, Collection efficiency, Testing of Solar collectors – IS code, Applications of Solar Energy, Solar Pond, Solar Energy storage & types. **08**

3. Solar Photovoltaic systems:

Operating Principle, Photovoltaic cell concepts, Photo-cell materials, Cell module array, Series and parallel connections, Applications & applications related to automobiles. **05**

4. Fuel Cells:

Introduction, Principle and operation of fuel cells, classification and types of fuel. Fuel for fuel cells, performance characteristics of fuel cells, application of fuel cells related to automobiles. **04**

SECTION – II

5. Wind Energy:

Wind parameters and wind data, Power from wind, Site selection, Wind energy conversion systems and their classification, Construction and working of typical wind mill, characteristics of wind generators, Design considerations for wind mills. **04**

6. Bioconversion:

Introduction, biological & biochemical conversion, Energy plantation, Combustion and fermentation, anaerobic digester, Biomass gasification, Pyrolysis, various applications of Biomass energy, Bio-fuel – Relevance, types, and applications. **03**

7. Energy form ocean:

Introduction to tidal, wave & OTEC and its types and conversion mechanisms. **02**

8. Geothermal Energy:

Types of geothermal resources, Methods of harnessing, Types of geothermal systems, environmental impact. **02**

9. Hybrid Systems:

Need for Hybrid systems, Range and type of hybrid systems, Case studies of Diesel-PV, Dual fuel systems, hybrid electric vehicles, etc. **03**

10. Energy Management:

Overview, National Energy Strategy of India. Energy planning, Energy conversion opportunities and measures. **03**

11. Energy Auditing:

Scope, types and case studies related to automobile vehicles. **03**

Term Work:

1. Demonstration and measurement of solar radiation.
2. Demonstration / trial on solar flat plate collector.
3. Demonstration & Performance evaluation of PV cell.
4. Demonstration on wind-solar hybrid power plant.
5. Study and demonstration of fuel cell.
6. Energy Audit – Case Study of automobile vehicle.
7. Visit to Bio-fuel plant.
8. Demonstration & layout of battery operated vehicle.
9. Study & demonstration of energy storage devices

Reference Books:

1. Solar Energy by Dr. S. P. Sukhatme Tata McGraw Hill.
2. Non Conventional Energy Sources by G.D.Rai.- Khanna Publishers.
3. Energy Technology by S. Rao, Dr. B.B.Parulekar Khanna Publishers.
4. Non Conventional Energy Sources by Dr. L. Umanand.
5. Introduction to Non Conventional Energy Resources by Raja, SciTech Publi.

B.E. (Automobile)

5. ELECTIVE – I

COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Teaching Scheme:
Lecturers: 3 Hrs/Week
Practical: 2 Hrs/ Week

Examination Scheme:
Theory: 100 Marks
Term work: 25 Marks

SECTION - I

1. Introduction:
Meaning, Scope, evolution, architecture, elements, benefits, limitations, obstacles in implementation, social aspects of CIM. **02**

2. CAD/CAM/CAE:
Product design and CAD/CAM, role of computers in design and manufacturing, integration of CAD/CAM, Role of CAD/CAM in CIM. **03**

3. Group Technology:
Concept, design and manufacturing attributes, part families, methods of grouping, PFA, different classification and coding systems (OPITZ and MICLASS), relevance of GT in CIM, benefits and limitations. **04**

4. Computer Integrated Planning:
Aggregate planning, master production schedule, capacity planning, MRP-I, computer aided process planning. **02**

5. Computer Integrated Control:
Shop floor control, factory data collection system, inventory management, MRP-II. **04**

6. Flexible Manufacturing Systems:
Concept, difference between rigid and flexible manufacturing, concept of cellular manufacturing, structure of FMS, components of FMS. **06**

SECTION - II

7. Computer Aided Quality Control:
Objectives, contact & non-contact inspection, types of contact and non-contact inspection, scope in CIMS, coordinate measuring machine: types, construction, working principle, working, applications, and scope of CMM in CIMS, flexible inspection system. **06**

8. Material Handling and Storage:
Introduction to MH, MH in CIMS, criteria for suitability of MH system for CIMS, MH equipments, AGV, Monorail vehicles, Robots in MH, AS/RS components, AS/RS control. **04**

9. Database Management System:

Meaning of Data, database, DBMS, design requirements, criteria, comparison of DBMS with conventional file handling, types of DBMS model, scope of DBMS in CIMS. **04**

10. Robots in CIMS:

Introduction, anatomy, configuration, scope of robots in CIMS. **03**

11. Communication in CIMS:

Requirements of shop floor communication, hierarchy of computer communication, types and components of communication systems in CIMS, Networking concepts, network topology, access methods, media, ISO-OSI reference model, introduction to MAP/TOP, role of computer communication in CIMS. **02**

12. Planning and Implementation Issues:

Need of planning, steps in planning, phases of CIMS implementation, partial and one time implementation, organization for CIM planning and implementation. **02**

TERM WORK

1. Fundamentals of part programming, manual part programming, G & M Codes, Subroutines, Canned cycles, do loop. (One assignment)
2. Manual part programming for 2d and 3d machining. (Minimum four programs)
3. Tool path generation using any suitable CAM software for two simple components.
4. One exercise on G.T.
5. One exercise on M.R.P.
6. Assignment on factory data collection system.

REFERENCE BOOKS:

1. Automotion, Production systems and Computer Integrated Manufacturing by M.P.Groover (PHI)
2. Computer Integrated Design and Manufacturing by Bedworth, Henderson Wo (McGraw Hill)
3. Performance Modeling of Automated Production System by Narhari and Vishvanandhan (PHI)
4. Principles of Computer Integrated Manufacturing by S. Kant Vajpayee (PHI)
5. CIM Handbook byTeicholtz and Orr (McGraw Hill)
6. CAD/CAM/CIM: Radhakrishnan, Subramanyam, Raju.
7. Computer Integrated Manufacturing: James Rehg, H.W.Kraebber, Pearson Education.

8 CAD/CAM/CAE Chougule N.K Scitech Publication

B.E. (Automobile)

5. ELECTIVE – I INDUSTRIAL PRODUCT DESIGN

Teaching scheme:
Lectures: 3hrs./week
Practical: 2hrs./week

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

SECTION -I

1. **Introduction:** Approach to industrial design.
   a. Approach to industrial product based on idea generation and innovativeness to meet the needs of the developing society. Design and development process of industrial products, various steps such as creative process involved in idea of marketing, mind criticism, design process, creation.
   b. Ergonomics and aesthetics requirement of product design, quality and maintainability consideration in product design. Use of modeling technique, prototype design, conceptual (conceptional) design.

   07

2. **Industrial Product Design**:
   a. General Design situations, setting specifications, requirements and ratings, their importance in design. Study of market requirements and manufacturing aspects of industrial design.
   b. Aspects of ergonomics design of machine tools, testing equipments, instruments, automobiles, process equipments, conventions of style, form & color in industrial design.

   08

3. **Design of consumer product**:
   a. Design concepts of consumer product, specification requirements and ratings of their importance in design, functions and use, standard and legal requirements, body/dimensions
   b. Ergonomic considerations, interpretation of information, conventions for style, forms, colors.

   06

SECTION -II

4. **Aesthetics concept:**
   a. Concept of unity and order with variety, concept of purpose, style and environment, aesthetic expressions of symmetry, balance, contrast, continuity, proportion, rhythm, radiance.
   b. Form and style of product, visual effect of line and form, mechanics of seeing, psychology of seeing, influence of line and form, component of style, basic factor, house style, effect of color on product appearance, color composition, conversion of colors of engineering products

   10

5. **Economic considerations**: Selection of materials, design for production, use of standardization, value analysis and cost reduction, maintenance aspect of product design

   05

6. **Design organization:** Organization structure, design position, drawing office procedure, standardization, record keeping, legal product of design patents.

06

Term Work:

1. Ergonomic design considerations of a machine tool
2. Ergonomic design considerations of a handling instruments of vehicle
3. Ergonomic design considerations of a testing equipment
4. Aesthetic design considerations of consumer products
5. Form design of a dashboard unit of a car
6. Conversion of colour of existing engineering products
7. Value analysis and cost reduction of engineering products
8. Collection of documents required for getting a patent
9. Case study on patented product analysis
10. Design of new product/ devices / utility articles

Reference Books:

1. Industrial Design for Engineers- W.H. Mayall, London Ilifle Books Ltd.
2. Problems of product Design and development – Hearn Buck, Pergamon Press.
3. Industrial Designs in Engineering- Cherles H. Flurscheirm, Design Council
4. The generation of Idea for new products- Trevor Sowecy, Kogan Page
5. Engineering Design conceptual stage- M. J. French, Heinman Education Books.

B.E. (Automobile)

5. ELECTIVE – I PRODUCTION MANAGEMENT

Teaching Scheme:
Lectures: 3 Hrs/ Week
Practical: 2hrs./week

Examination Scheme
Theory : 100 Marks (3 hrs duration)
Term work : 25 marks

SECTION - I

1. Introduction:
Definition, scope and objectives of Production Management, Relationship of production with other management functions, Interdepartmental relationship, Production operation strategies **03**

2. New Product Design:
Need, characteristics of phases of product life cycle, Product characteristics analysis, Market, functional, operational, quality, reliability, ergonomics, Economic consideration, FMECA, QFD **06**

3. Production Function:
Process design frame work, Work station, Line balancing, Different techniques, Batch Production, Minimum cost, Maximum profit, Production range, Process planning - Factors, steps, Selection of technology, Selection of equipment, Flow design **08**

4. Applications:
Application of Quantitative techniques for production decision Simulation, Sequencing, Queuing **03**

SECTION - II

5. Capacity Planning:
Definition and basic concepts, Long term and short term capacity strategies, Aggregate planning - strategies and guidelines, LP approach to aggregate planning, MPS **06**

6. Plant Maintenance:
Principles, need, policies and objectives, Types of maintenance, Reliability and life testing, TPM. **04**

7. Capital Investment Decisions:
Concept, Types, Concept of time value of money, Evaluation techniques. Replacement Analysis – Concept, Types, Evaluation Techniques **04**

8. Project Management:

Project identification and formulation, Market, Technical economic and financial feasibility, Project scheduling and monitoring – CPM and PERT techniques, PMIS, Project Quality Assurance **08**

Term Work:

Minimum Ten from the Following List:

1. Case study on Interdepartmental relationship
2. New Product Development- Case problems with economic consideration.
3. Problems on Present value, future value, effective interest rate, NPV, IRR
4. Problems on Replacement analysis- 2 on each type.
5. Problems on – selection of machines and Line Balancing
6. Batch production – Min. cost, max profit and production range determination
7. Process planning and selection of appropriate machines.
8. Aggregate Planning, MPS - problems.
9. Reliability - 5 problems on system reliability
10. Project Feasibility study.
11. Network Analysis.
12. Operation Research application in Production Management.

Reference Books:

1. Adam EE, RJ Ebert, Production and operation management- Prentice Hall Englewood Cliff, N.J.
2. Riggs. J L - Production system, Planning, Analysis and Control – John Weily and sons, New York.
3. James Dilworth, Production and Operation Management- McGraw Hill Book Company, New York.
4. Martand Telsang, Industrial Engineering and Production Management- S Chand & Co, New Delhi.
5. Prasanna Chandra, Project Appraisals
6. Buffa. E.S, Modern production and Operation Management- Willey, New Delhi.
7. Barry Shore- Operation Management- McGraw Hill Book Company, New York.
8. Samuel Eilon – Production planning and control.
9. Joseph Monks, Operation Management, Theory and Problems, McGraw Hill Book Company, New York.
10. Maintenance Handbook.

B.E. (Automobile)

6. INDUSTRIAL CASE STUDY EVALUATION

Teaching scheme:
Practical: 2 hrs/ alternate week

Examination scheme:
Term work: 25 marks

The student has to undergo Industrial Training of minimum Two Weeks in summer vacation, after T.E.(Automobile) - II, in an automotive / auto component manufacturing industry. Each student has to prepare a report on industrial training of about 25 pages of "A4" size sheets in single bound copy.

An external assessment of his training will be done based on the quality of the work & preparation and understanding of the candidate.

Format for the report:

- Title sheet
- Department certificate
- Training certificate signed by industry authority
- Industry profile (Organization structure, Layout, functioning etc.)
- Manufacturing/Testing processes
- List of machineries with emphasis on special purpose machines
- Daily reports signed by competent industrial authority
- Training outcomes

(Note- Concern project guide should assess & sign the certificate)

B. E. (Automobile)

7. ENGINE TESTING

Teaching scheme:
Practical: 2 hrs/week

Examination scheme:
Term Work: 25 marks
Practical & Oral: 50 marks

Term work (Minimum Ten):

1 Introduction to ISI codes for engine testing
2. To trial on multi-cylinder petrol engine – Morse test
3. Trial on multi-cylinder petrol engine – Variable speed test
4. Trial on single cylinder diesel engine – heat balance sheet
5. Trial on single cylinder petrol engine - Variable speed test
6. Trial on computerized single cylinder diesel engine
7. Trial on computerized multi-cylinder diesel engine
8. Measurement of air/fuel ratio of diesel engine
9. Measurement of air/fuel ratio of petrol engine
10. Trial on single cylinder petrol engine – constant speed test
11. Trial on single cylinder diesel engine (Friction power)
12. Trial on Multicylinder engine (LPG)

Recommended Books:

1. I.C. Engine, 3rd Edition, V. Ganeshan, Tata McGraw Hill
2. I. C. Engine, V. L.Maleev, McGraw Hill Book Co. Ltd., New Delhi, Second Edition
3. Fundamentals of I. C. Engine, Gill P. W., Smith J. H., Zurich E. J. Oxford & IBH Pub. Co., New Delhi.
4. I.C. Engine & Air Pollution – E. F. Obert, Harper & Row Publishers, New York
5. I. C. Engine, Mathur & Sharma, Dhanpat Rai & Sons, New Delhi
6. I. C. Engine Fundamentals, Heywood J.B., Mc Graw Hill Book Co., New Delhi
7. I. C. Engine, Litchy

B.E. (Automobile)

8. PROJECT PHASE I

Teaching scheme:
Practical: 2hrs/Alternate week

Examination scheme:
Term work: 50 marks

Term Work:

Number of students in a Batch may be up-to five. Group of project depends on the nature of project, may be 2, 3, 4 or 5. A batch of 10 students shall work under the guidance of one faculty.

The student will submit a progress report based on the project work undertaken by project group.

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

1. Work diary maintained by the student and duly 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 calculations, drawings etc. carried by the student.

B.E. (Automobile)

1. REFRIGERATION AND AIR CONDITIONING

Teaching Scheme:
Lecturers: 3 Hrs/ Week
Practicals: 2 Hr./ Alternate Week

Examination Scheme:
Theory: 100 Marks
Term work: 25 Marks

SECTION - I

1. Review of Thermodynamics: 03
Laws, General equations, Processes, Equations applied to processes, definitions & methods of refrigeration.

2. Basic Refrigeration Cycles: 08
Carnot cycle, Reversed Carnot cycle, Simple Vapour compression cycle, sub-cooling, superheating, Liquid to suction vapour heat exchanger, Calculations and performance of above cycles, Actual vapor compression cycle, air standard refrigeration cycles such as Bell Coleman cycle, Air cycles for air crafts refrigeration.

3. Refrigerants: 05
Classification, requirements of refrigerants like Thermodynamic, physical, & chemical. Comparison among commonly used refrigerants, Selection of Refrigerants, Effect on Ozone depletion and global warming, Alternative Refrigerants.

4. Refrigeration Equipments: 05
Compressor, Condenser, Evaporator, Expansion devices, Types & performance characteristics, selection, methods of charging and leak testing.

SECTION-II

5. Psychrometry: 07

Moist air as a working substance, Psychrometric properties of air, Use of Psychrometric tables and charts, Processes, Combinations and Calculations, ADP, Coil Condition line, Sensible heat factor, Bypass factor.

6. Comfort: 02
Thermal exchange between human body and environment, factors affecting comfort, effective temperature comfort chart, ventilation requirements, outside & inside design conditions.

7. Heating and Cooling Load Calculation: 07

Representation of actual air conditioning process by layouts and on psychrometric charts, Load analysis RSHF, GSHF, ESHF, Enumeration and brief explanation of the factors forming the load on refrigeration and air conditioning systems, load calculation of automobile vehicle for comfort and transport air conditioning. Energy conservation in air conditioning systems.

8. Air Distribution System: 05

Re-circulated air, Ventilation air, Duct work, Use of friction loss and rectangular equivalent of round duct chart, duct system, principle of duct sizing and air distribution, it's norms, diffusers, dampers, layout, duct systems.

Term Work:

1. Study of various methods of transport refrigeration systems
2. Study and demonstration on car & bus air conditioning systems.
3. Study and demonstration of controls in refrigeration.
4. Study / Trial on heat pump.
5. Study of defrosting methods
6. Trial on refrigeration bench
7. Trial on air conditioning system.
8. Trial on Cascade system.
9. Study of multi-pressure refrigeration system

Reference Books:

1. Principles of Refrigeration - Roy J. Dossat
2. Refrigeration and Air Conditioning - Stoker
3. Refrigeration and Air Conditioning - C. P. Arora
4. Refrigeration and Air Conditioning - Arora Domkundwar
5. Refrigeration and Air Conditioning - V. K. Jain
6. Air Conditioning Principles and Systems - Pita
7. Air Conditioning Applications and Design - W. P. Jones
8. Air Conditioning Engineering - W. P. Jones
9. Thermal environmental engineering – Tnerellaild
10. ASHARE Handbooks
11. Mitchell Information services, Inc., Mitchell automatic heating & air conditioning systems, Prentice Hall, Inc.
12. Paul Weisler, Automotive air conditioning, Reston Publishing Co. Inc.

B.E. (Automobile)

2. AUTOMOTIVE ELECTRONICS

Teaching scheme:	**Examination scheme:**
Lectures : 3hrs/week	Theory Paper: 100 marks (3 hrs duration)
Practical: 2hrs/ week	Term work : 25 marks

SECTION – I

1. **Introduction to automotive electrical systems** : Automotive generation, storage & distribution systems, wiring harness, circuit diagrams and symbols, 12/24/42 volt system, positive earth and negative earth, earth return and insulated return systems, Multiplexed wiring systems, Electromagnetic compatibility, Electromagnetic interference, Controlled Area Networks (CAN) 03

2. **Battery** : Types, Principle of lead acid battery, Constructional details, Recharging the battery, Battery ratings, Battery Performance, Battery capacities, Battery efficiency, Battery tests, Battery failures, Alkaline battery, maintenance free batteries, hybrid batteries 05

3. **Charging Systems & Regulators:** D.C. Generators, A. C. Generators, Magnetos Constant current & voltage systems, Current & voltage regulator, Semi conductor type regulator, Regulator for alternators 07

4. **Starting Systems:** Requirements of Starting system, starting system layout, selection of motor, matching battery, Drive mechanisms, Permanent magnet motors 03

5. **Ignition systems**: Introduction, types, Ignition coil, Distributor, Cam angle & Contact angle gap, Advance mechanisms, Ballast Resistance, Limitations of coil ignition, Transistorized Ignition systems, Spark plugs, types, construction 04

SECTION – II

6. **Lighting systems**: Fundamentals, Headlight, types, lighting circuits, interior lighting, signaling, LED lighting, Gas discharge lighting 02

7. **Automotive Equipments & Accessories** : Fuel gauge, oil pressure gauge, Temperature gauges, Speedometer, Warning Lights, Electric Horn, Horn Relay, Wind Shield wipers, Heaters & defrosters, Electric windows. 02

8. **Automotive Sensors & Actuators**: Types of sensors, actuators, Airflow rate sensor, angular position sensor, Throttle angle sensor, Temperature sensor, sensors for feedback control, engine control actuators, Solenoid actuators, motorized actuators. 04

9. **Automotive Electronic Systems** : Electronic Ignition systems, Electronic injection systems, Antilock brake system circuit, Traction control, Electronic control of automobile transmission, Active suspension, Engine management system, ESP 06

10. **Electric and hybrid vehicles**: Types, Energy sources – batteries, Fuel cells, Solar and Hydrogen, Electric machines and controllers, Design considerations, challenges and recent developments 06

Term work: (Minimum ten)

1. Demonstration of automotive electrical and electronic systems layout
2. Demonstration of battery charging & battery testing
3. Demonstration and testing of alternators
4. Demonstration & testing of starting motors
5. Demonstration of electronic ignition system
6. Demonstration of dash board panel instruments & controls
7. Demonstration of headlight beam alignment
8. Testing of auto electrical components on multifunction tester
9. Testing of CDI coil, spark plug and armature
10. Demonstration of microcontroller 8051
11. Demonstration of electric bike and hybrid vehicle
12. Demonstration of ECU diagnostic system

Books Recommended:

1. Tom Denton, 'Automobile Electrical & Electronic Systems', SAE International
2. Young, Griffithe, 'Automobile Electrical & Electronic Equipments', The English Language Book Co., London.
3. Bechfold SAE 1998, 'Understanding Automotive Electronics'.
4. V.A.W.Hilliers, 'Fundamentals of Automotive Electronics', Hatchin, London
5. Tomwather J. R., Cland Hunter, 'Automotive Computer & Control System', Prentice Inc. NJ
6. Robert N. Brandy, 'Automotive Computers & Digital Instrumentation', Prentice Hall Eaglewood, Cliffs, NJ
7. John Hartly, 'The Fundamentals of Electrical Systems', Longman Scientific & Technical
8. Wiliam B. Ribbens, 'Understanding Automotive Electronics', SAE International
9. P. L. Kohli, 'Automotive Electrical Equipments', Tata McGraw Hill Pub. Co. Ltd.
10. Henning Wallentowitz, Christian Amsel, '42 Volt Powernets'
11. Daniel J. Holt, '42 Volt Electrical system', SAE USA
12. Michel Westbrook, 'The electric and hybrid electric car', SAE International
13. Iqbal Hussain, 'Electric & Hybrid vehicles – Design fundamentals', CRC Press

B.E. (Automobile)

3. AUTOMOTIVE SYSTEM DESIGN

Teaching scheme:
Lectures: 3hrs./week
Practical: 4hrs./week

Examination scheme:
Theory Paper: 100 marks (3 hrs. duration)
Term work : 25 marks
Oral : 25 marks

SECTION – I

1. Statistical Considerations in Design:

Statistics in design, design for natural tolerances, statistical analysis, mechanical reliability. **04**

2. **Design of Clutches:**

Design requirements of friction clutches, selection criterion, torque transmission capacity, lining materials, Design of single plate clutch, multi-plate clutch and centrifugal clutch **08**

3. **Design of Gearbox:**

Selection of gear ratios & final drive ratio, Design of gears, shafts, splines and housing, selection of bearings **06**

4. Final Drive Design
Design of final drive & differential gearing, Selection of wheels and tyres, **03**

SECTION-II

5. **Brake Systems:**

Design of Hydraulic Braking System, Internal Expanding Shoe Brake and Disc Brake. **05**

6. **Design of Axles & Propeller Shafts**:

Design of front & rear axles, Design of Propeller shafts for bending, torsion & rigidity, Design of universal joints and slip joints. **05**

7. **Design of Suspension System**:

General design considerations of suspension system, Design of leaf springs for automobile suspension system, Design considerations of Belleville springs, Elastomeric springs, Air (Pneumatic) springs. **06**

8. **Optimization**:

Introduction to design optimization of mechanical elements, adequate & optimum design, methods of optimization, Johnson's method of optimum design-Simple problems in optimum design like axially loaded members, shaft subjected to torsional and bending moments and other machine elements. **05**

Term Work: (Minimum **two**)

1. Design & working details and assembly drawing of automotive clutch system. Shall comprise of:
    - Functional design of clutch
    - Design of clutch shaft, hub and flange
    - Design of damper springs
    - Design of sectors, rivets etc.
    - Design of pressure plate assembly
    - Design for linkage mechanism
    - Details and assembly drawing

2. Design & working details and assembly drawing of automotive gear box. Shall comprise of:
    - Calculation of gear ratios
    - Determination of number of teeth on gear pair
    - Determination of gear reductions
    - Design of gear pairs
    - Design of shafts
    - Selection of bearings
    - Details and assembly drawing

3. Design of automotive brake system.

Reference Books:

1. Joseph E. Shigley & Larry D. Mitchell, 'Mechanical Engineering Design', Fourth Edition, McGraw-Hill International Book Company.
2. Patil S.P., 'Mechanical System Design', 2nd edition, Jaico Publishers
3. M. F. Spotts & T.E. Shoup, 'Design of machine Elements', Seventh Edition, Pearson Education.
4. Bhandari V. B., 'Design of Machine Elements', Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. Julian Happian – Smith, 'An Introduction to Modern Vehicle Design', Butterworth Heinemann
6. Pandya N.C.& Shah C.S., 'Elements of Machine Design', Twelth Edition, 1994, Charotar Publishing House.
7. R.C. Johnson, 'Optimum Design of Mechanical Elements', John Wiley & Sons.
8. J.S. Arora, 'Introduction to Optimum Design', McGraw-Hill Book Company Ltd.

B.E. (Automobile)

4. VEHICLE PERFORMANCE

Teaching scheme:	**Examination scheme:**
Lectures: 3hrs/week	Theory paper: 100 marks (3 hrs duration)
Practical: 2hrs/week	Term work : 25 marks
	Oral examination: 25 marks

SECTION – I

1. Need and importance of vehicle testing, Vehicle Performance parameters: Fuel economy, acceleration, deceleration, gradability, top speed, handling, comfort, life durability, safety. 04

2. Vehicular transmission performance: Characteristics and comparison of automotive clutches, Geared transmission, Epicyclic transmission, Torque converter, Testing of clutch, gear box, final drive and differential. Test procedure **05**

3. Vehicular system performance: Suspension, steering, Brakes & carriage unit testing, test procedure, Tyre Testing – Tyre wear pattern identification and causes, Endurance test, Strength test, High speed performance test **03**

4. Vehicle Testing: 09

- Road test
- Test tracks – proving ground testing, high speed track, pavement track, corrugated track, mud track, steering pad, gradient track, deep wading through shallow water.
- Laboratory testing – testing on chassis dynamometer, accelerated testing, designing test procedure.
- Virtual testing

SECTION – II

5. Safety: Motor vehicle safety standards, active safety, passive safety, bio-mechanics Structural safety, energy absorption, ergonomic consideration in safety, Occupants safety systems – seat belts, head retrain, air bags, roll-over protection system, Electronic stability program. **06**

6. Crash testing: Human testing, Dummies, crashworthiness, pole crash testing, rear crash testing, vehicle to vehicle impact, side impact testing, crash test sensors, sensor mounting, crash test data acquisition. **05**

7. Noise & vibration: Mechanism of noise generation, engine noise & vibration, causes and remedies, road shocks, wind & vehicle noise measurement, Pass by noise, In cab noise, floor vibrations. **06**

8. Automobile testing instrumentation: Sensors – types and selection, Instrumentation for functional tests, component test, endurance test, model test and full scale test. **04**

Term Work: (Minimum Ten)

1. Estimation of power requirement or vehicle propulsion
2. Engine testing for finding performance characteristic
3. On road fuel consumption measurement of vehicle
4. Brake efficiency measurement
5. Noise measurement in passenger compartment
6. Vibration measurement in passenger compartment
7. Vehicle performance testing on chassis dynamometer.
8. Demonstration of vehicle component testing
9. Report based on visit to vehicle testing & research organization
10. Report based on visit to vehicle crash testing
11. Estimation of vehicle body moments.

Reference Books:

1. J. Y. Wong , Theory of Ground Vehicles, A wiley Interscience Publications
2. Hans Herman Braess, Ulrich Seiffert, Handbook of Automotive Engineering, SAE Publications
3. Rao V. Dukkipati, Jian Pang, Road Vehicle Dynamics, SAE Publications
4. Wolt, Heinrich Hucho, Aerodynamics of road vehicles, SAE Publications
5. Bosch, Automotive Handbook, SAE Publications
6. George Pieters Barbara Pieters, Automotive Vehicle Safety
7. Michel Plint Engine Testing Theory and Practice
8. Gousha H. M., “Engine performance Diagnosis & Tune Up Shop Manual”
9. J.G .Giles, “Vehicle Operation & Performance”.
10. W. H. Crouse & D. L. Anglin, “Motor Vehicle Inspection”.
11. SAE Transaction Papers – 831814/820346/820367/820371/820375

B.E. (Automobile)

5. ELECTIVE – II TRANSPORT MANAGEMENT

Teaching scheme:
Lectures: 3 Hrs. /Week

Examination scheme:
Theory Paper: 100 Marks (3 hrs duration)

SECTION – I

1. Motor Vehicle Act:

Short titles & definitions, Laws governing to use of motor vehicle & vehicle transport, Licensing of drivers & conductors, Registration of vehicle, State & interstate permits, Different types of RTO forms, Rules regarding construction of motor vehicles, Central Motor Vehicle Rules & amendments, Government administration structure - Organization & management of motor vehicle department, Traffic rules, Signals & controls, responsibility of driver, Public relations & public authorities, Accidents, Causes & analysis, Liabilities & preventive measures, Offences, penalties & procedures, Personnel, Authorities & duties. **09**

2. Taxation :

Objectives, Bombay Motor Vehicle Taxation Act, Structure & methods of laving taxation, Onetime tax, Tax exemption & tax renewal **05**

3. Insurance :

Significance & types of insurance, Comprehensive, Third party insurance, Furnishing of particulars of vehicles involved in accident, Award of the claims tribunal, MACT (Motor Accident Claims Tribunal), Solatium Fund, Hit & run case, accident claims & survey report including post accident procedures, Duty of driver in case of accident, Surveyor & Loss Assessor.

07

SECTION – II

4. Passenger Transport Operation:

Structure of passenger transport organizations, introduction to road corporation act, Typical depot layouts, requirements, Problems on fleet management, Fleet maintenance, Bus & Crew Scheduling, significance of Motor Transport Workers act, personnel & training - training for drivers & conductors, Public relations, passenger amenities, advertisement work, Theory of fares, Basic principles of fare charging, Differential rates for different types of services, Depreciation & debt charges, operation cost, Revenues, Economics & records. Management Information System (MIS) in passenger transport operation.

10

1. Goods Transport Operation:

Structure of goods transport organizations, scheduling of goods transport, Freight calculations, Management Information System (MIS) in goods transport operation, storage & transportation of petroleum products. **07**

2. Advance Techniques in Traffic Management –

Vehicle & traffic navigation system, global positioning system, advanced traffic control devices, Intelligent Transport System. **04**

Reference Books:

1. Motor Vehicle Act - Govt. of India Publications.
2. Santosh Sharma, "Productivity in Road Transport", 2nd Edition, Association of State Road Transport Undertakings, New Delhi.
3. P.G.Patankar, "Road Passenger Transport in India", CIRT, Pune.
4. S.K. Shrivastava, "Economics of Transport"
5. "Transport Development in India", S. Chand & Co. Pvt. Ltd., New Delhi.
6. Gupte & Dighe, "Motor Vehicle Laws in Maharashtra", Hind Publications.
7. Bus Transport operation, L. Kitchin

B.E. (Automobile)

5. ELECTIVE - II

ENTREPRENEURSHIP DEVELOPMENT

Teaching scheme:	**Examination scheme:**
Lectures: 3 Hrs. /Week	Theory Paper: 100 Marks (3 hrs duration)

SECTION – I

1. Entrepreneur: Definition, Concept, importance, nature, types, entrepreneurial culture, growth, entrepreneurial traits & motivations. 04

2. Entrepreneurship: Theory, Aspects, environment for entrepreneurship, The process of entrepreneurial development training, Barrier to entrepreneurship, Integrated – contextual model for Entrepreneurship. 05

3. Project identification: concept of Project & classification, Searching for business idea, opportunity finding, Project formulation. Project design & net work analysis. 06

4. Setting Up of SSI: steps for starting small scale industry, whom to approach for what, incentives and subsidies, Role of state development, finance corporations, noodle agencies, Role of consultancy Organization, Lead Bank, various clearances & certificate required for a particular industry. 06

SECTION – II

5. Project Report: Project Report preparation, feasibility report, marketing research, Project appraisal, factory design and Layout, Interviews with Industrialist, case studied. 06

6. Industrial Finance: Financial appraisal, Long term loan, short term loan, over drafts, letter of credit, working capital management. 04

7. Costing and Accounting: Direct and Indirect costs, Break-even analysis, Financial projections, statement of cash flow, Balance Sheet, Profit and loss account, accounting ratios, Income tax, Sales Tax(VAT),Excise Tax(CEN VAT) 06

8. Problems to entrepreneurship: SSI – sickness, reasons and remedies, Revival of sick unit, Role of BIFR (rehabilitation schemes) 05

Reference Books:

1. Dynamics of Entrepreneurial Development and Management -By Vasant Desai, Himalaya Publishing House, Delhi
2. Management of small scale Industries, -By Vasant Desai; Himalaya Publishing House, Delhi
3. Small Scale Industries and Entrepreneurship, -By Vasant Desai, Himalaya Publishing House, Delhi
4. Entrepreneurship Development and Management -By Neeta Bopodikar, Himalaya Publishing House, Delhi
5. Project Profiles for S.S.I. Mechanical Products;

B.E. (Automobile)

5. ELECTIVE – II

TRACTOR AND FARM EQUIPMENT

Teaching scheme:
Lectures: 3 Hrs. /Week

Examination scheme:
Theory Paper: 100 Marks (3 hrs duration)

SECTION – I

1. General Design of Tractors
Classification of tractors - Main components of tractor - Safety rules. **04**

2. Fundamentals of Engine Operation
Tractor controls and the starting of the tractor engines - Basic notions and definition - Engine cycles – Operation of multicylinder engines - General engine design - Basic engine performance characteristics. **07**

3. Engine Mechanism of Tractor
Cylinder and pistons - Connecting rods and crankshafts - Engine balancing – Construction and operation of the valve mechanism - Valve mechanism components - Valve mechanism troubles. **09**

SECTION – II

4. Cooling System, Lubrication System And Fuel System Of A Tractor
Cooling system - Classification - Liquid cooling system - Components, Lubricating system servicing and troubles - Air cleaner and turbo charger - Fuel tanks and filters – Fuel pumps. **06**

5. Farm Tractor Transmission System:
Layout, Load distribution, Transmission & Drive line, Steering, Braking system, Wheels & Tyres, Hydraulic system, Auxiliary Systems, Draw bar, PTO Shaft. **07**

6. Farm Equipments-
Working attachments of tractors - Farm equipment - Classification - Auxiliary equipment - Trailers and body tipping mechanism. **09**

Reference Books:

1. E.L.barger, J.B.Liljedahl,W.M.Carleton, E.G.Mckibben “Tractors & their power units”
2. Rodichev and G.Rodicheva, “Tractor and Automobiles ", MIR Publishers, 1987.
3. Kolchin. A., and V. Demidov "Design of Automotive engines for tractor ", MIR Publishers, 1972.

B.E. (Automobile)

5. ELECTIVE – II MAINTENANCE MANAGEMENT

Teaching scheme:
Lectures: 3 Hrs. /Week

Examination scheme:
Theory Paper: 100 Marks (3 hrs duration)

SECTION - I

1. Introduction:

Fundamentals of Maintenance Engineering, Maintenance engineering its importance in material & energy conservation, Inventory control, Productivity, Safety, Pollution control etc. Safety Regulations, Pollution problems, Human reliability, Total quality management (TQM), Total productivity maintenance (TPM), Environmental issues in maintenance, ISO 9000. 07

2. Maintenance Management

Types of maintenance strategies, Planned and unplanned maintenance, Breakdown, Preventive & Predictive maintenance their comparison, Advantage & disadvantages. Limitations, Computer aided maintenance, Maintenance scheduling, Spare part management, Inventory control, Organization of maintenance department. 07

3. Tribology in Maintenance

Friction wear and lubrication, Friction & wear mechanisms, Prevention of wear, Types of lubrication mechanisms, Lubrication processes. Lubricants- types, General and special purpose, Additives, Testing of lubricants, Degradation of lubricants, Seal & packing. 07

SECTION – II

4. Machine Health Monitoring

Condition based maintenance, Signature analysis, Oil analysis, Vibration, Noise and thermal signatures, On line & off line techniques, Instrumentation & equipment used in machine health monitoring. Instrumentation in maintenance, Signal processing, Data acquisition and analysis, Application of intelligent systems, Data base design. 09

5. Reliability, Availability & Maintainability (RAM) Analysis

Introduction to RAM failure mechanism, Failure data analysis, Failure distribution, Reliability of repairable and non-repairable systems, Improvement in reliability, Reliability testing, Reliability prediction, Utilization factor, System reliability by Monte Carlo Simulation Technique. 12

References Books :

1. Gopal Krishnan and Banerji, Maintenance & Spare parts Management, PHI
2. Mishra and Pathak, Maintenance Engineering and Management, PHI
3. S.K. Shrivastava, Industrial Maintenance Management.
4. CNR Rao, Handbook of Condition Monitoring, Higgins, Maintenance Engineering Hand Book.

B.E. (Automobile)

5. ELECTIVE-II OPERATION RESEARCH

Teaching Scheme: **Examination Scheme:**
Lecturers: 3 Hrs/ Week **Theory: 100 Marks** (3 hrs duration)

SECTION-I

1. Introduction:
History and development of OR, Applications, modeling in OR, OR models and their applications. 02

2. Linear Programming Problems:
Formulation of problem, Graphical solution, Simplex procedure for maximization and minimization, Duality concept. 07

3. Assignment Model:
Mathematical statement, Methods to solve balanced and unbalanced assignment Problems, Maximization problems, Assignment with restrictions, Traveling salesman problem. 06

4. Replacement & Maintenance analysis
Introduction, types of maintenance, types of replacement problem, determination of economic life of an asset 06

SECTION II

5. Transportation Model:
Mathematical formulation, methods to obtain initial basic feasible solution (IBFS), NWCR and VAM, conditions for testing optimality, MODI method for testing optimality solution of balanced and unbalanced problems, Degeneracy and its resolution. 06

6. Decision Theory:
Introduction, Pay off table, Opportunity loss or regret table, Decisions under uncertainty, Laplace Criterion, Maximin or minmax principle, maximax or minimax principle, Hurcuilicz principle, Decisions under risk–maximum likelihood criteria, Expectation principle, Expected opportunity loss or expected regret decision trees. 05

7. Queuing Model:
Introduction, Kendall's notation, Classification of queuing models, Sequencing of n jobs and 2 & 3 machines, 2 jobs and m machines. 04

8. Inventory control
Introduction, models of inventory, operation of inventory system, Quantity discount, fixed order quantity system, periodic quantity system EOQ model. 06

REFERENCE BOOKS:

1. Operations Research – J.K. Sharma, McMillan India Publi. New Delhi
2. Operations Research – Hiza & Gupta, S.Chand & Co. New Delhi
3. Introduction to Operation Research – Hamdy A. Taha, Prentice Hall India Publi.
4. Production and Operation Management -Tripathy Scitech Publication
5. Engineering Management Chithambaranathan Scitech Publication
6. Optimisation in Engineering –Biswal by Scitech Publication
7. Operations Research Manohar Mahajan Dhanapat Rai And Sons
8. Engineering Optimisation Methods And Application ARavindran
9. K.M. Ragdell G.V. Rklaitis Willey India Ltd

B.E. (Automobile)

6. PROJECT

Teaching scheme:
Practical: 5 hrs/ week

Examination scheme:
Term work: 75 marks
Oral : 75 Marks

Term Work:

The project work submitted by the student started at B.E. Part – I shall be according to following guidelines –

Format of project report –

The project report shall be typed with 1.5 line space on A4 size bond paper. The total number of pages shall not be more than 150 and not less than 60 including figures, graphs, annexures etc. as per requirement. The report shall be written in the following format -

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

The student has to present the project work in front of the faculty members of the department and his classmates. The faculty members, based on the quality of the work & preparation and understanding of the candidate, shall do an internal assessment of the project for his term work.

EQUIVALENCE FOR B.E.(Automobile. Engg.)

Sr.No.	**Subjects as per Pre- revised Syllabus**	**Subjects as per revised Syllabus**
B.E. Auto Semester – I		
1	Finite Element Method	Finite Element Analysis (BE Semester – VII)
2	Automobile Body Engineering	Vehicle Body Engineering (TE Semester – VI)
3	Automobile Maintenance	Maintenance Management Elective – II (BE Semester VIII)
4	Automobile Electrical & Electronics	Automotive Electronics (BE Semester – VIII)
5	Elective - I	
	Two & Three Wheelers	Automobile Transmission (TE Semester – V)
	Alternative Fuels & Energy Systems for Automobile	Alternative Fuels & Emission (BE Semester – VII)
	Entrepreneurship Development	Entrepreneurship Development (BE Semester – VII)
B.E. Auto Semester – II		
1	Automobile Dynamics	Vehicle Dynamics (BE Semester – VII)
2	Vehicle Performance	Vehicle Performance (BE Semester – VIII)
3	Transport Management	Transport Management Elective – II (BE Semester – VIII)
4	Automobile Emission & Control	Alternative Fuels & Emission (BE Semester – VII)
5	Elective - II	
	Special Purpose Vehicle	Tractor & Farm Equipment Elective – II (BE Semester – VII)