SCHEME OF STUDIES & EXAMINATION FOR

MASTER OF TECHNOLOGY

IN AUTOMOBILE ENGINEERING

M. D. UNIVERSITY, ROHTAK
SCHEME OF STUDIES & EXAMINATIONS
MASTER OF TECHNOLOGY (Automobile Engineering)

SEMESTER I

S.no	Course code	Course Title	Teaching schedule			Class work	Examination		Total
			L	T	P		Theory	Practical	
1	MAE 501	Design of Experiments & Research Methodology	3	0	0	50	100	-------	150
2	MAE 503	Automotive Engines & Emission	3	0	0	50	100	-------	150
3	MAE 505	Theory of Elasticity & Reliability	3	0	0	50	100	-------	150
4	MAE 507	Transmission System Theory & Design	3	0	0	50	100	-------	150
5		Elective – I	3	0	0	50	100	-------	150
6	MAE 5L1	Theory of Elasticity & Reliability lab	0	0	2	25	------	25	50
7	MAE 5L3	Transmission System Theory & Design Lab	0	0	2	25	------	25	50
8	MAE 5S1	Seminar – I	0	0	2	50	------	-------	50
		Grand Total	15	0	6	350	500	50	900

Note :

1. The paper setter will set each theory paper of 100 marks covering the entire syllabus.
2. The sessionals of Theory and Practical Courses shall also be evaluated on the basis of above marks.
3. The gracing system will be according to rules of M.D.University
4. In the Semester examination the examiner will set 8 questions in all covering the entire syllabus and Students will be required to attempt only 5 questions.
5. Use of Scientific calculator will be allowed in the examination. However Programmable calculator and cellular phone will not be allowed

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SEMESTER II

S.no	Course code	Course Title	Teaching schedule			Class work	Examination		Total
			L	T	P		Theory	Practical	
1	MAE 502	Engine Design	3	0	0	50	100	-------	150
2	MAE 504	Chassis & Body Engg.	3	0	0	50	100	-------	150
3	MAE 506	Vehicle Dynamics	3	0	0	50	100	-------	150
4	MAE 508	Noise & Vibration	3	0	0	50	100	-------	150
5		Elective – II	3	0	0	50	100	-------	150
6	MAE 5L2	Engine Design Lab	0	0	2	25	------	25	50
7	MAE 5L4	Chassis & Body Engineering Lab	0	0	2	25	------	25	50
8	MAE 5S2	Seminar – II	0	0	2	50	------	-------	50
		Grand Total	15	0	6	350	500	50	900

Note :

1. The paper setter will set each theory paper of 100 marks covering the entire syllabus.
2. The sessionals of Theory and Practical Courses shall also be evaluated on the basis of above marks.
3. The gracing system will be according to rules of M.D.University
4. In the Semester examination the examiner will set 8 questions in all covering the entire syllabus and Students will be required to attempt only 5 questions.
5. Use of Scientific calculator will be allowed in the examination. However Programmable calculator and cellular phone will not be allowed

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MASTER OF TECHNOLOGY (Automobile Engineering)

SEMESTER III

S.no	Course code	Course Title	Teaching schedule			Class work	Examination		Total
			L	T	P		Theory	Practical	
1	MAE 601	Vehicle Instrumentation & Testing	3	0	0	50	100	-------	150
2	MAE 603	Computer Aided Vehicle Design	3	0	0	50	100	-------	150
3		Elective III	3	0	0	50	100	-------	150
4	MAE 6L1	Computer Aided Vehicle Design lab	0	0	3	50	------	50	100
6	MAE 6S1	Seminar – III	0	0	2	50	-------	-------	50
5	MAE 6DI	Dissertation – Phase I	0	0	4	100	-------	-------	100
		Grand Total	9	0	9	350	300	50	700

Note :

1. The paper setter will set each theory paper of 100 marks covering the entire syllabus.
2. The sessionals of Theory and Practical Courses shall also be evaluated on the basis of above marks.
3. The gracing system will be according to rules of M.D.University
4. In the Semester examination the examiner will set 8 questions in all covering the entire syllabus and Students will be required to attempt only 5 questions.
5. Use of Scientific calculator will be allowed in the examination. However Programmable calculator and cellular phone will not be allowed

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SEMESTER IV

S.no	Course code	Course Title	Teaching schedule			Class work	Examination		Total
			L	T	P		Theory	E.Viva	
1	MAE 6DF	Dissertation FINAL Phase	0	0	24	200	-------	400	600
2	MAE 6S2	Seminar – IV	0	0	02	50	-------	-------	50
		Grand Total	0	0	26	250	-------	400	650

Note :

1. The paper setter will set each theory paper of 100 marks covering the entire syllabus.
2. The sessionals of Theory and Practical Courses shall also be evaluated on the basis of above marks.
3. The gracing system will be according to rules of M. D.University
4. In the Semester examination the examiner will set 8 questions in all covering the entire syllabus and Students will be required to attempt only 5 questions.
5. Use of Scientific calculator will be allowed in the examination. However Programmable calculator and cellular phone will not be allowed

M. D. UNIVERSITY, ROHTAK
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MASTER OF TECHNOLOGY (Automobile Engineering)

LIST OF ELECTIVES

S.no	Course code	Course Title	Teaching schedule			Class work	Examination		Total
			L	T	P		Theory	Practical	
Elective I									
1	MAE 5E1	Finite Element Analysis	3	0	0	50	100	-------	150
2	MAE 5E3	Hydraulic & Pneumatic Systems	3	0	0	50	100	-------	150
3	MAE 5E5	Automobile Air Conditioning	3	0	0	50	100	-------	150
Elective II									
1	MAE 5E2	Human Resource Development	3	0	0	50	100	-------	150
2	MAE 5E4	Advanced Automotive Electronics	3	0	0	50	100	-------	150
3	MAE 5E6	Automotive Maintenance & Management	3	0	0	50	100	-------	150
4	MAE 5E8	Tribology	3	0	0	50	100	-------	150
Elective III									
1	MAE 6E1	Combustion Engineering	3	0	0	50	100	-------	150
2	MAE 6E3	Numerical analysis and optimization	3	0	0	50	100	-------	150
3	MAE 6E5	Design of bearings and shaft	3	0	0	50	100	-------	150
4	MAE 6E7	Computational fluid dynamics	3	0	0	50	100	-------	150

*Student has to take one subject out of subjects offered by department from this list.

Note :

1. The paper setter will set each theory paper of 100 marks covering the entire syllabus.
2. The sessionals of Theory and Practical Courses shall also be evaluated on the basis of above marks.
3. The gracing system will be according to rules of M.D.University
4. In the Semester examination the examiner will set 8 questions in all covering the entire syllabus and Students will be required to attempt only 5 questions.
5. Use of Scientific calculator will be allowed in the examination. However Programmable calculator and cellular phone will not be allowed

M.Tech. (Automobile Engineering) – Semester – I

MAE 501 Design of Experiments & Research Methodology

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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.

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.

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 Montgomary, "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

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MAE 503 **Automotive Engines & Emission**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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

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

MAE 505 **Theory of Elasticity & Reliability**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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

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

MAE 507 **Transmission System Theory & Design**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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 Transmission systems: 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, and 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,

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

Reference Books :

1. The Automotive Chassis – Engineering Principle – Reimpell J.
2. Automotive Chassis – Design & Calculation – P. Lukin, G. Gasparyarts, 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

MAE 5L1 **Theory of Elasticity & Reliability lab**

L-T-P
0-0-2

Term work Marks: 25
External practical Marks: 25
Total Marks: 50
Exam duration:2 hrs

List of Experiments

1. Experiments using strain gauges.
2. Measurement of strain, temperature effects
3. Fixing of gauges on surfaces.
4. Experiments using photo elastic bench.
5. Setting of polariscope and calibration of disc, beam and tension model. Measurement of stress and stress by using strain gauges.
6. Measurement if stresses by using photo elastic bench.
7. Observation of photo chromatic fringes by using photo elastic bench.

MAE 5L3 **Transmission System Theory & Design Lab**

L-T-P
0-0-2

Term work Marks: 25
External practical Marks: 25
Total Marks: 50
Exam duration: 2 hrs

List of Experiments

1. Study of clutches
2. Study of gear box.
3. Study of transmission shaft
4. Study of brakes
5. To design differential using matlab.
6. To design axles using matlab.

MAE 5E1 **Finite Element Analysis**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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.

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Reference 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. Fagaan, 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 (P0 Ltd., New Delhi.
9. O C Zienkiewicz. The Finite Element Method. Tata McGraw-Hill Publishing Co Ltd., New Delhi.

MAE 5E3 **Hydraulic & Pneumatic Systems**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

Introduction to fluid power – Classification, application in various fluids of engineering, various hydraulic 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

a) Requirement of pressure control, direction control, flow control valves.

b) 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.

c) 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.

d) Actuators – linear and rotary, hydraulic motors, types of hydraulic cylinders and their mountings.

e) 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.

Refrence Books:

1. Basic fluid power- D.A. Pease-PHI
2. Industrial Hydraulic & pneumatics – J.J. Pippenger - McGraw Hill
3. Fluid with applications – A. Esposito- PHI
4. Oil Hydraulics – B Lal- Intl- Literature
5. Fluid power Design Hand book – Yeaple
6. Industrial Hydraulic Manual Vicker Sperry
7. Practical guide to Fluid Power H.S. Stewart

MAE 5E5 **Automobile Air Conditioning**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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.

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

MAE 5S1 **SEMINAR – I**

L-T-P Term work: 50 marks
0-0-2

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.

M.Tech. (Automobile Engineering) – Semester – II

MAE 502 **Engine Design**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

Introduction: 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 deign, 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

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Reference Books:

1. I. C. Engine & Air Pollution – E. F. Obert, Harper & Row Publishers, New York
2. Engine Design – Giles J. G., Lliffe 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

MAE 504 **Chassis & Body Engineering**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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.

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.

MAE 506 **Vehicle Dynamics**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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, Akerman'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.

Reference Books:

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

MAE 508 **Noise & Vibration**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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 free vibration, modes, nodes, Holzer's method. Multi degree of freedom of vibration, matrix method, eigen values and vectors, natural frequencies & modes,

Model 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, Rayliegh's method, Reyliegh-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 model analysis.

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

MAE 5L2 **Engine Design Lab**

L-T-P
0-0-2

Term work Marks: 25
External practical Marks: 25
Total Marks: 50
Exam duration: 2 hrs

List of Experiments:

1. Heat balance sheet of IC engine
2. Design of cylinder using simulation software.
3. Design of connecting rod using simulation software.
4. Design of piston using simulation software.
5. Study of engine vibration sources

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MAE 5L4 **Chassis & Body Engineering Lab**

L-T-P
0-0-2

Term work Marks: 25
External practical Marks: 25
Total Marks: 50
Exam duration: 2 hrs

Students have to use the drafting, designing and simulation software to do the experiments

List of experiments:

1. To study different parts of chasis
2. To do and study the Wheel alignment
3. To do and study wheel balancing
4. To do and study the different loading conditions of chasis
5. To study and design a chasis

MAE 5E2 **Human Resource Development**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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, peered comparison method, critical incident method, behavioral, anchored rating scale.

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

MAE 5E4 **Advanced Automotive Electronics**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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 sensorcranking 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,

Reference Books:

1. Automobile Electrical & Electronic Equipments - Young, Griffitns - 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 – Wiliam B. Ribbens, Allied Publishers Pvt. Ltd., Chennai.
8. Automobile Electrical & Electronic Systems – Tom Denton, Allied Publishers Pvt. Ltd., Chennai.

MAE 5E6 **Automotive Maintenance & Management**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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

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

MAE 5E8 **Tribology**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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: Natural 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 journals 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, thixotopic, materials and Bingham solids, grease lubrication and care stability, tribology components in extreme environments like vacuum, pressure, temperature, tribology matching and selection, tribolo-testing and standards.

Reference Books:

1. Friction and Lubrication, Bowden F.P. & Tabor D., Heinemann Edu. Books Ltd. 1974
2. Friction & Wear of Material, Ernest Rabinowiez
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, & Sternlincht 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

MAE 5S2 **Seminar – II**

L-T-P Term work marks: 50
0-0-2

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.

M.Tech. (Automobile Engineering) – Semester – III

MAE 601 Vehicle Instrumentation & Testing

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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 pickups, 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.

Reference Books:

1. Engineering Experimentation – Ernest O. Doeblin
2. Experimental Methods for Engineers – Holman J.P., McGraw Hill Book Co.
3. Measurement Systems, Applications & Design – Ernest O Doeblin, 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.

MAE 603 **Computer Aided Vehicle Design**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

Vehicle Frame and Suspension: Study of Loads — Moments and Stresses on Frame Members. Computer Aided Design of Frame for Passenger and Commercial Vehicles.

Computer Aided Design of Leaf Springs-Coil Springs and Torsion Bar Springs.

Front Axle and Steering Systems: Analysis of Loads-Moments and Stresses at different sections of Front Axle. Determination of Bearing Loads at Kingpin Bearings. Wheel Spindle Bearings. Choice of Bearings.Determination of Optimum Dimension and Proportions: for Steering Linkages ensuring minimum error in Steering.

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

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

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

Reference Books:

1. Dean Averns, “Automobile Chassis Designs” Illiffe Books 1992.
2. Heldt. P.M., “Automotive Chassis” Chilton Book Co., New York 1992.
3. Steeds. W., “Mechanics of Road Vehicles” liliffee Books 1990.
4. Giles, J.G. “Steering, Suspension and Tyres” liliffee Books 1988.
5. Newton, Steeds & Garret.”The Motor Vehicle”, Illiffee Books 1982.
6. Heldt., P.M. “Torque Converter”. Chilton Book Co., New York, 1982.
7. Gin, N.K., “Automobile Technology” Khanna Publisher, 2004

MAE 6L1 **Computer Aided Vehicle Design Lab**

L-T-P
0-0-2

Term work Marks: 25
External practical Marks: 25
Total Marks: 50
Exam duration: 2 hrs

Practicals will include illustrative design of vehicle parts e.g. main frame, suspension etc. and their Simulations in computer will also be carried out covering the Contents of MAE 603.

MAE 6E1 **Combustion Engineering**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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,

Reference 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

MAE 6E3 **Numerical analysis and optimization**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

System of linear algebraic equations and Eigen value problems: elimination method, Gauss method, Gauss-Jordan method; Eigen values and Eigen vectors, bounds on Eigen values, Jacobi methods for symmetric matrices, householder's method for symmetric matrices.

Interpolation and approximation: interpolation problem, linear interpolation, Lagrange interpolation, Newton interpolation, interpolation with equidistant points, spline interpolation, least square approximation

Numerical differentiation and integration: differentiation of continuous functions, forward difference quotient, central difference quotient, error analysis; derivatives from differences table, higher-order derivatives, Richardson extrapolation techniques, Newton-Cotes method, trapezoidal rule, Simpson's rule, higher order rules, Romberg integration. Numerical solution of ordinary differential equations: Taylor's series method, Euler and modified Euler method, Runge-Kutta methods, Milne's method, Adam-Bashforth-Moultan method.

Optimization: basic concept of optimization, classification of optimization, optimization techniques, engineering applications of optimization. Classical optimization techniques: unconstrained optimization single-variable optimization, multivariable optimization, multivariable optimization, multivariable optimization with equality constraints: solution by direct search method, solution by Lagrange-multipliers method, multivariable optimization with inequality constraints, Kuhn-Tucker conditions

Non-linear optimization: general non-linear programming problem, classification of non-linear programming problem, unconstrained optimization techniques: direct search method, gradient method. Constrained optimization techniques: separable programming, quadratic programming

Dynamic programming: Multistage decision process: representation of a multistage decision process, coversion of nonserial system to a serial system, types of multistage decision problems, principle of optimality, computational procedure in dynamic programming, linear programming as a case of dynamic programming, application of dynamic programming.

Reference Books:

1. Engineering Optimization, *by* SS Rao; New Age International Ltd.
2. Numerical Method, *by* E. Balaguruswamy; Tata McGraw Hill.

3. Numerical methods for Scientific & Engineering Computation, *by* MK Jain, SRK Iyengar and RK Jain; New Age International Ltd.
4. Operations Research, *by* Taha H Hamidi; Prentice Hall of India, New Delhi
5. Operations Research, *by* Philips, Revindran, Solgebery; Wiley ISE
6. Applied Numerical Analysis, *by* Curtis F Gerald & Patrick G Whealley; Pearson Education Ltd.
7. Introductory Methods of Numerical Analysis, *by* SS Sastry; Prentice Hall of India, New Delhi

MAE 6E5 **Design of bearings and shaft**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

Sliding contact bearings Bearing classification; tribology and hydrodynamics; factors affecting choice of bearing; characteristics; types of friction in sliding element bearing; viscosity of lubricants; types of sliding contact bearings; Petroffs relation for power loss; unstable and stable lubrication; hydrodynamic theory of bearing: load carrying capacity of bearing; heating of bearings; practical bearing design; finite length bearings; pressure fed bearing.

Bearing materials: bearing bronzes, babbits, copper lead alloys, aluminium tin alloy, other bearing materials; bearing types; design of journal bearing.

Rolling contact bearings Types of rolling contact bearing: radial ball bearings, angular contact ball bearings, roller bearings; friction torque due to load; frictional torque due to viscous churning of lubricants; heating of roller bearing; rolling bearing geometry; stress and deformation in rolling element; bearing deflection; permanent deformation in bearings; fatigue of rolling bearing; selection of bearing; load on bearing; combined bearing load; bearing life; equivalent load; bearing dimension code.

Shafts Materials for shafts; strength of shafts under torsion and bending; factor of safety in shafts: fatigue strength reduction factors, modified moments of inertia of shaft section; stiffness of shafts: factors affecting shaft deflection. Complete design calculation and checking of stress concentration, shafts for power transmission through belts and gears. Shaft vibrations

Reference Books:

1. Machine Design by Abdul Mubeen; Khanna Publishers
2. Machine Design by Shiegley; McGraw Hill
3. Design of Machine Elements by Bhandari, McGraw Hill Education

Reference book(s):

1. Machine Design by Black And Adams, McGraw Hill Education
2. Design of Machine Elements by Spotts

MAE 6E7 **Computational Fluid Dynamics**

L-T-P
3-0-0

Term work Marks: 50
Theory Marks: 100
Total Marks: 150
Exam duration: 3 hrs

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 technique Introduction – Lax – Wendroff technique, MacCormackls 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.

Numerical solution: 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

Reference Books

1. John D. Anderson, “Computational Fluid Dynamics: The Basics with application”, McGraw Hill, New Delhi.
2. W. Kanzman, 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

MAE 6S1 **Seminar – III**

L-T-P Term work marks: 50
0-0-2

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.

MAE 6DI **Dissertation – Phase I**

L-T-P Term work marks: 100
0-0-4

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.Tech. (Automobile Engineering) – Semester – III

MAE 6DF **Dissertation**

L-T-P
0-0-24

Term work marks: 200
External viva marks: 400

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)

MAE 6S2 **Seminar – IV**

L-T-P Term work marks: 50
0-0-2

Student has to choose topic of his interest in an emerging area with approval of supervisor and Committee, appointed by Head of the Department for this purpose. He has to do an in depth exhaustive study on his topic throughout the semester under the guidance of his supervisor. At the end of the semester, student has to submit report. He will present his work in a seminar. Evaluation will be based on continuous monitoring of his contribution during the semester by his supervisor and the report and seminar evaluation by the Committee appointed by Head of the Department.