

M.Tech in Automobile Engineering

(Semester – 1)

S.No.	Subjects	Evaluation (Marks)		
		Internal	External	Total
1.	Automatic Control System	40	60	100
2.	Advanced Thermal Engineering	40	60	100
3.	Automotive Material and Metallurgy	40	60	100
4.	Automobile Engineering	40	60	100
5.	Automotive Electronics	40	60	100
6.	Alternate fuels and Lubricants	40	60	100

(Semester – 2)

S.No.	Subjects	Evaluation (Marks)		
		Internal	External	Total
1.	Internal Combustion Engines	40	60	100
2.	Automotive Chassis	40	60	100
3.	Automotive Transmission	40	60	100
4.	Tribology	40	60	100
5.	Vehicle Dynamics	40	60	100
6.	Automotive Design	40	60	100

(Semester – 3)

S.No.	Subjects	Evaluation (Marks)		
		Internal	External	Total
1.	CAD/CAM - Lab	40	60	100
2.	Advance Automobile Engineering - LAB	40	60	100
3.	Project Phase - I	40	60	100
4.	Seminar	40	60	100

(Semester – 4)

S.No.	Subjects	Evaluation (Marks)		
		Internal	External	Total
1.	Project Phase - II	40	60	100
2.	Thesis Evaluation	80	120	200
3.	Thesis Viva-Voce	40	60	100

(Semester – 1)

Automatic Control System

1. **Introduction:** Types of control systems, block diagram, performance analysis, regulators and servo mechanism, analog and digital control system
2. **Control Elements:** Block diagram representation, representation of system and process, liquid, gas, mechanical and thermal system, hydraulic servo motor, control valve, comparison element, closed and open loop, polar plots, rectangular plots, routh criterion
3. **Control System Design:** Introduction, addition of poles and zeros, compensation, root locus design
4. **Control Application:** Machine tool control, boiler control, engine governing-mechanical, hydraulic, electric, pneumatic, carburetor, diesel fuel control, gyroscopes, active and vibration control
5. **Sequential control:** Introduction, input and output devices, diagrams, fluid devices, ladder devices, hydraulic and pneumatic actuation system

Ref Books

Theory and applications of automatic controls - *B C Nakra*

Automatic Control System - *By V.U.Bakshi U.A.Bakshi*

Elements of control systems - *Sudhir K. Gupta*

Automatic control systems, Volume 1 – *by Benjamin C. Kuo, Farid Golnaraghi*

(Semester – 1)

Advanced Thermal engineering

1. **Basic Concepts:** theory of gases, thermodynamics, macro and micro properties, state, process, cycle, pressure, specific volume, reversible and irreversible, work and heat, entropy, phase change, introduction to first law and second law of thermodynamics, carnot cycle, rankine cycle, regenerative cycle
2. **Gases:** p-v-t, real gases, gases equations , corresponding state, Dalton law, gas mixture, vapour mixture
3. **Fuel and Combustions:** classification of fuels, solid, liquid, gas fuels, stoichiometric fuel ratio , fuel analysis, chemical equilibrium, flame temperature, internal energy
4. **Generator and boilers:** classification of boilers, comparison, boiler terms, fire tube boiler, water tube boiler, high pressure boiler, boiler mountings, factors evaporations, boiler efficiency,
5. **Steam Engines:** Reciprocating- general aspects, definition, classification, working of steam engines, terminology, diagram, indicate power, brake power, saturation and performance curves, Compound- introduction, advantage, classification, losses, uniflow steam engines, multi cylinder steam engines
6. **Turbine and condenser:** Intro, classification, impulse turbine, reaction turbine, efficiency, types of power, classification of condenser, condenser efficiency,, air pumps, cooling towers
7. **Air Compressor:** classification of reciprocating and rotary, reciprocation compressor terminology, reciprocation air compressor, roots blower compressor, vane type compressor, centrifugal compressor, free air delivery(FAD)
8. **Air conditioning:** applications, effective temperature, summer and winter AC systems, AC cycles, central AC systems, heat factor

Ref Books:

Thermal engineering – *By R.K. Rajput*

Thermal Engineering - *By Mahesh M Rathore*

Thermal Engineering - *By K. Soman*

Engineering thermodynamics - *By P.K. Nag*

(Semester – 1)

Automotive Material and Metallurgy

1. **Introduction:** classification, requirements, properties, material structure, crystal structure, space lattice, crystal system, body centered cubic structure(BCC), face centered cubic structure(FCC), atomic packing factor, types of bonds, bond formation, types of crystal imperfection
2. **Diffusion and deformation:** what is diffusion, applications, classification, mechanism, diffusion coefficient, what is deformation, types of deformation, work hardening, season cracking, baushinger effect, cold working, hot working, recovery, grain growth
3. **Heat treatment:** introduction, processes, annealing, normalizing, hardening, tempering, types of hardening, phase transformation and its mechanism, eutectic systems, eutectoid system, peritectic and peritectoid
4. **Corrosion:** introduction, factors of corrosion, types of corrosion, control, prevention of corrosion, creep, mechanical properties, mechanical test, fractures, technical property of metal
5. **Metallurgy:** introduction, application, advantages, disadvantages, limitation, design consideration, process description, powder metallurgy and fabrication

Ref Books:

Material Science - By G. K. Narula, K. S. Narula, V. K. Gupta

Material Science & Engineering – By I.P. Singh, Subhash Chander, R.K. Prasad

Material Science - By S.L. Kakani

Engineering Materials 1: An Introduction to Properties, Applications and Design - By Michael F. Ashby, D R H Jones

(Semester – 1)

Automobile Engineering

1. **Introduction:** Introduction to automobiles, components of automobiles, basic structure, power plant, transmission, control and auxiliaries, suspension systems, clutches, brakes, steering system, classification of automobile, introduction to chassis construction, conventional construction, sub frames, frameless construction
2. **Transmission:** Clutches, requirement of clutches, types of clutches, clutch operation, function of transmission, need of transmission types of transmission, manual transmission, automatic transmission, epicyclical gear box, propeller shafts, differential, continuous variable transmission
3. **Suspensions:** Introduction, requirements, functions, types of suspensions, leaf spring, coil spring, independent suspension, suspension troubleshooting
4. **Chassis:** Front axle, wheel alignment, steering geometry, steering mechanism, power steering, types of wheels, wheel dimensions, tyre, types of tyres, principle of brakes, requirement of brakes, types of brakes, drum brakes, disc brakes, lighting system of car, wiring circuit, headlights, indicating lights,
5. **Engines:** Engine terminology, engine cycles, firing order, working of engine, design consideration, types of engines, arrangement of engine cylinders, cooling system of car, method of cooling, radiator, coolant pump, lubrication in cars, requirement, types of lubricants
6. **Emission Control:** Introduction, reduction of pollutants, engine emissions, hydrocarbon emissions, hydrocarbon emission in SI and CI engine, CO emission, oxide of nitrogen, particulates, other emissions, emission control, catalytic convertor, crankcase blow by
7. **Performance Parameters:** Engine power, Engine efficiencies, engine performance characteristics, methods of improving engine performance.

Ref Books

Automobile Engineering (Vol 1 and 2) - By Kirpal Singh

Automotive Mechanics – By Crouse and Anglin, TATA Mcgraw Hill

A Text Book of Automobile Engineering - By R.K. Rajput

Automobile Engineering - By Ttti, K K Jain R B Asthana, Bhopal, Jain & Asthana

(Semester – 1)

Automotive Electronics

1. **Introduction:** Ohm's law, unit of electricity, atoms, electrons, conductors, semi conductors, diode, transistor, insulators, electromagnetism, electromagnets, generator, battery, regulator, starting system, ignitions system, lighting system, +ve and -ve earthing.
2. **Charging system:** Battery, lead acid battery, principle of operation, construction, voltage of cell, chemical actions, recharging battery, battery test, battery charging, alkaline battery, generator, simple generator, automobile generator, alternators,, types of alternators, regulations of alternators, regulators, third bush regulators
3. **Starting system :** Cranking motor, principles, requirement, construction of cranking motor, power requirement, cranking motor drive mechanism- bendix drive, folo-thru drive, barrel type drive, rubber compression drive, friction clutch drive, over running clutch
4. **Ignition System:** Introduction, ignition coil, distributor, cam angle and contact point gap of ignition system, spark advance mechanism, centrifugal advance, special ignition system and devices, spark plug, requirement, types, construction of spark plug, magneto ignition system, principle of magneto, low tension and high tension magneto, special types of magnetos, booster coil, impulse starter
5. **Lighting System:** Introduction, light sources, headlights, control of headlights, adjusting headlights, for lamps, brakes warnig light, ignition warning lighjt, parking lights, horn relay, lighting relay.

Ref Books:

Automotive Electrical Equipement - By P.L. Kohli

Automobile Engineering (1 & 2) – By Kirpal Singh

(Semester – 1)

Alternate fuels and Energy

1. **Introduction:** Need for alternate fuel, availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources. Like EV, hybrid, fuel cell and solar cars.
2. **Alcohols:** Properties as engine fuel, alcohols and gasoline blends, performance in SI engine, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, DME, properties performance analysis, performance in SI & CI Engines.
3. **Natural Gas, LPG, Hydrogen & Biogas:** Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG using LPG in SI & CI engines, performance and emission of LPG, Hydrogen, storage and handling, performance and safety aspects.
4. **Vegetable Oils:** Various vegetable oils for engines, classification, performance in engines, performance and emission characteristics, bio diesel and its characteristics.
5. **Electric, Hybrid, Fuel Cell & Solar Cars:** Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar powered vehicles.

Ref Book:

Alternative Fuels Guide Book - by Richard L. Bechfold, SAE International Warrendale – 1997.

Energy today & tomorrow - by Maheswar Dayal, I & B Horishr – 1982

Power Plant Engineering - by Nagpal, Khanna Publishers – 1991.

(Semester – 2)

Internal Combustion Engines

1. **Introduction:** Energy conversion, engine definition, basic engine components, working principle of engine, classification of engines, application, engine performance parameters, Carnot, stirling, ericsson, otto cycles, diesel cycle, dual cycle, comparison
2. **Air Fuel Cycles:** Introduction, significance, composition of cylinder gases, dissociation, comparison air standard and air fuel cycles, time loss factor, heat loss factor, exhaust breakdown
3. **Fuels:** Diff types of fuels, chemical structure, qualities of engine fuels, alternate fuels, solid fuels, liquid fuels, hydrogen engine fuels, other possible fuels
4. **Carburetion:** Carburetor, air fuel mixtures, requirement of air fuel mixture, principle of carburetion, construction of carburetor, types of carburetor
5. **Injection System:** Requirement of injection system, fuel feed pump, injection pump, diff types of governors, fuel nozzle, gasoline injection, types of gasoline injection, electronic fuel injection system, MPFI, electronic control system
6. **Ignition System:** Requirement of ignition, ignition system, requirement of ignition system battery ignition system, operation, limitation, dwell angle. Firing order, igniting timing
7. **Combustion:** homogeneous and heterogeneous mixture, combustion in SI engines, stages of combustion, knocking in SI engines, combustion chamber for SI engine
8. **Lubrication and Cooling:** function of lubrication, mechanism, types of lubrication, lubrication of engine components, lubrication systems, additives for lubricants, need for cooling system, characteristics, types of cooling system- liquid cooling and air cooling

Ref Books:

Internal Combustion Engines 3e - *By Ganesan*

The Internal-combustion Engine in Theory and Practice: Thermodynamics, fluid - *By Charles Fayette Taylor*

Internal Combustion Engines - *By K. Agrawal Shyam, Shyam K Agrawal*

Internal Combustion Engines - *By R.K. Rajput*

(Semester – 2)

Automobile Chassis

1. **Introduction:** What is chassis, basic structure, requirement of chassis, conventions construction, sub frames, defects in frames, frameless construction
2. **Suspension System:** Object of suspension system, basic requirement, functions, types of suspension springs, leaf springs, construction and types of leaf spring, torsion bars, shock absorbers or dampers, independent suspension, anti roll device, air suspension, hydrostatic suspension,
3. **Axle and Steering:** Front axle, wheel alignment, factors, steering geometry, camber, castor, toe in, toe out, steering mechanism, cornering force, under steer and over steer, steering linkages, steering gears, steering ratio, power steering, four wheel steering, steering adjustment, checking wheel alignment and steering geometry
4. **Wheels and Tyres:** types of wheels, wheel dimensions, tyre, tyre property, carcass tyre, radial and bias ply tyre, tyre material, tread designing, tyre section, nitrogen in tyres, tyre colour, flat running tyre
5. **Brakes:** principle, requirement, efficiency, weight distribution, types of brakes, drum brakes, disc brakes, hydraulic brakes, brake fluid, electric brakes, servo brake system, air brakes, brakes drum, brake shoe, brake lining, anti lock braking system, electric hydraulic braking system
6. **Body:** Requirement of body, construction details, power door locks, remote entry, material, painting, rust protection

Ref Book:

Automobile Engineering Vol-1 - *By Kirpal Singh*

Automotive Mechanics – *By Crouse and Anglin, TATA Mcgraw Hill*

A Text Book of Automobile Engineering - *By R.K. Rajput*

Automobile Engineering - *By Ttti, K K Jain R B Asthana, Bhopal, Jain & Asthana*

(Semester – 2)

Automotive Transmission

1. **Introduction:** History of Automotive Transmissions, Basic Innovations, Development of Vehicles and Drive Units, Transmission Components, Development of Torque Converters and Clutches, Basic Elements of Vehicle and Transmission, Performance Features of Vehicle Transmissions.
2. **Power Flow and Conversion:** Power Requirement-Wheel Resistance, Adhesion, Air Resistance, Acceleration Resistance, Diversity of Prime Movers, Torque/Engine Speed Characteristic, Powertrain, Total Ratio and Overall Gear Ratio, Velocity/Engine-Speed Diagram.
3. **Transmission Design:** Arrangement of the Transmission, Transmission Formats and Designs, Basic Gearbox Concept, Passenger Car Transmissions, Final Drives, Gearwheel Performance Limits, Developing Low-Noise Transmissions.
4. **Gearshifting Mechanisms:** Classification of Shifting Elements, Layout and Design of Synchronizers-Functional Requirements, Design of Synchronizers Engineering Designs, Alternative Transmission Synchronizers, Layout and Design of Multi-Plate Clutches-Multi-Plate Clutch Requirements, Design of Multi-Plate Clutches.
5. **Electronic Transmission Control:** Networked Systems, Electronic Transmission Control Unit (TCU), TCU Structure, Operating Conditions and Construction, Control System, Clutch Actuator, Transmission Control Functions

Ref Books:

Automotive Transmission - By Harald Naunheimer · Bernd Bertsche · Joachim Ryborz · Wolfgang Novak

Automobile Engineering Vol-1 - *By Kirpal Singh*

Automotive Mechanics – By Crouse and Anglin, *TATA Mcgraw Hill*

A Text Book of Automobile Engineering - *By R.K. Rajput*

Automobile Engineering - *By Ttti, K K Jain R B Asthana, Bhopal, Jain & Asthana*

(Semester – 2)

Tribology

1. **Introduction:** Definition, significance, types of viscosity and their relationship, Thermal properties of lubricants, Temperature characteristics of lubricants, Types of mineral oils, Synthetic oils, Hydrocarbon synthetic lubricants, Greases, Grease characteristics, Lubricant additives, Corrosion control additives
2. **Abrasive, Erosive and Cavitations Wear:** Introduction, Abrasive wear, Mechanisms of abrasive wear, Modes, Abrasive wear resistance of materials, Effect of temperature on abrasive wear, Effect of moisture on abrasive wear, Erosive wear, Mechanisms of erosive wear, Erosive wear by liquid, Mechanism of cavitations wear
3. **Adhesion and Adhesive Wear:** Introduction, Mechanism of adhesion, Metal-metal adhesion, Metal-polymer adhesion, Metal-ceramic adhesion, Polymer-polymer and ceramic-ceramic adhesion, Effects of adhesion between wearing surfaces, Control of the adhesive wear, Favorable combinations of sliding materials
4. **Corrosive and Fatigue Wear:** Corrosive wear, Transition between corrosive and adhesive wear, Synergism between corrosive and abrasive wear, Oxidative wear, Fatigue wear during sliding, Surface crack initiated fatigue wear, Subsurface crack initiated fatigue wear, Effect of lubrication on fatigue wear during sliding, Fatigue wear during rolling, Causes of contact fatigue, Hydraulic pressure crack propagation
5. **Extreme Pressure Lubrication:** Introduction, Low temperature - low load lubrication mechanisms, Low temperature - high load lubrication mechanisms, Physisorption, Chemisorption, High temperature - medium load lubrication mechanisms, Chain matching, High temperature - high load lubrication mechanisms

Ref Books:

Engineering Tribology – By G.W. Stachowiak and A.W. Batchelor

Introduction to tribology - *By Bharat Bhushan*

Engineering tribology - *By Gwidon W. Stachowiak, Andrew W. Batchelor*

Fundamentals of tribology - *By Ramsey Gohar, Homer Rahnejat*

(Semester – 2)

Vehicle Dynamics

1. **Tyre and Rim Fundamentals:** Tyre sidewalls and components, radial and non radial tyres, wheel and rim, vehicle classification, tread
2. **Forward Vehicle Dynamics:** Car parked and accelerating on level road and inclined road, tyre stiffness, tyre print force, effective radius, rolling resistance, longitudinal, lateral, camber and tyre force, engine dynamics, driveline efficiency, gearbox dynamics, clutch dynamics
3. **Steering Dynamics:** Kinematics steering, vehicle with trailer, steering mechanism, four wheel steering, steering mechanism optimization, trailer truck kinematics
4. **Suspension Mechanism:** Solid axle suspension, independent suspension, roll center and roll axis, car tyre angles, suspension coordinate requirement
5. **Vehicle vibrations:** Force and Moment, Rigid Body dynamics, Vehicle Coordinate Frame, Force System Acting on a Rigid Vehicle Mechanical Vibration Elements, Newton's Method and Vibrations, Frequency Response of Vibrating Systems, Vibration Application and Measurement, Lagrange Method and Dissipation Function

Ref Books:

Vehicle dynamics: theory and applications - *By Reza N. Jazar*

Tyre and vehicle dynamics - *By H. B. Pacejka*

(Semester – 2)

Automotive Design

1. **Introduction:** Definition, classification of machine design, general procedure in machine design, mass and weight, SI units, moment of inertia, torque, work, power, design synthesis, use of standard design
2. **Shafts:** Transmission shafts, shaft design on strength, shaft design on torsional rigidity, design of hollow shaft on strength basis and torsional rigidity basis, flexible shafts,
3. **Belt Drives:** Introduction, selection, types of belt drives, material used for belts, working stress in belts, density of belt material, belt speed, coefficient of friction belt joints, creep of belt, velocity ratio of belt, ratio of driving tensions, centrifugal tensions
4. **Springs:** Intro, types of springs, material for helical springs, stresses, deflection, buckling of compression springs, composite springs, flat spiral spring, leaf springs, automobile suspension springs
5. **Clutches:** Intro, types of clutches, material for clutches, friction clutches, single disc clutches, multiplate clutches, cone clutches, centrifugal clutches
6. **Brakes:** Intro, material for brakes, types of brakes, single block brake, pivoted block brakes, double block brake, simple band brake, differential band brake, internal expanding brake
7. **IC Engine Parts:** Intro, principal part of IC engine, cylinder and cylinder liner, design of cylinder, piston, design consideration of piston, piston rings, piston skirts, piston pin, connecting rod, crankshaft, valves, rocker arms

Ref Books:

A Text Book of Machine Design - *By R.S. Khurmi and J.K, Gupta*

Design Of Machine Elements 3E - *By V. B. BHANDARI*

A Text Book of Machine Design - *By Rajendra Karwa*

Design of machine elements - *By C. S. Sharma, Kamlesh Purohit*

CAD/CAM – LAB

1. Computer aided design of frame for passenger & commercial vehicle.
2. Computer aided design of front axle.
3. Computer aided design of 3 & 4 speed gear boxes
4. Computer aided design of final drive gearing.
5. Design a single cylinder, 4 stroke, 125 CC displacement engine. Optimize connecting-rod/crank ratio & bore/stroke ratio.
6. Design a three cylinder, 4 stroke, 800 CC displacement engine. Optimize connecting- rod/crank ratio & bore/stroke ratio.
7. Design vehicle configuration – 2 wheeler (drive arrangements)
8. Design vehicle configuration – 3 wheeler (drive arrangements)
9. Design vehicle configuration – 4 wheeler (front engine)
10. Design vehicle configuration – 4 wheeler (rear engine)
11. Design vehicle configuration – 4 wheeler (multi axle drive)

Advanced Automobile Engineering - LAB

1. To study the layout of an automobile repair, service and maintenance shop.
2. To study & prepare the list of different types of tools, equipment, instruments and records required for the repair and maintenance works.
3. To perform the minor and major tuning of gasoline and diesel engines.
4. To perform cleaning and testing of spark plugs, fuel injectors.
5. To perform/understand the routine servicing, testing and trouble shooting, overhauling of a clutch and gear box assembly.
6. To study and inspect wear & tear by measurement of engine components.
7. To find out adjustment of brakes (Disc/Drum) and hand brake system for appropriate brake pedal play and to perform the bleeding of hydraulic brakes.
8. To find out the faults in electrical ignition system, gasoline fuel system and diesel fuel system.
9. To study and analyze service manuals of one petrol and one diesel engine driven vehicle.
10. To carry out load test of petrol /CNG vehicle.
11. To carry out load test of diesel vehicle.
12. Dismantling/assembly of 3-cylinder petrol engine of a car
13. Dismantling/assembly of 4 stroke single cylinder engine of two wheeler.
14. Dismantling/assembly of front axle/rear axle.
15. Dismantling/assembly of differential.