Course contents

Category	Title	Code	Credits-4C			
Elective-I	Special Types of Vehicles	MMAE 301 (A)	L	T	P	
			3	1	0	

UNIT I POWER UNITS, IGNITION SYSTEMS ELECTRICAL SYSTEMS of Two & Three Wheelers
Classifications- design considerations –weight and dimension limitations –requirements stability problems, gyroscopic effect- pendulum effect of two and three wheelers. 2 stoke and 4 stoke SI engines and CI engines design criteria for engines – design of cylinders, cylinder head, cooling fins, crank case, connecting rod and crank shaft. Carburettor types and design. Battery coil ignition, magneto ignition and electronic ignition. Lighting and other electrical system.

UNIT II CLUTCHES, TRANSMISSION, FRAMES, SUSPENSION, WHEELS AND TYRES
Types of clutches for 2 and 3 wheelers. Design of clutch system. Gears for two and three wheelers. Design of gear box and gear change mechanism. Belt, chain and shaft drive. Free wheeling devices, starting systems. Types of frames used for two wheelers. Wheel frames- construction design of frames for fatigue strength torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details of wheel and tyres.

UNIT III EARTH MOVING AND CONSTRUCTIONAL EQUIPMENTS
Construction layout, capacity and applications of earthmovers for dumpers, front-end loaders, bulldozers, excavators, backhoe loaders, scrappers, motor graders etc. criteria for selection of prime mover fro dumpers and front end loaders based on vehicle performance characteristics.

UNIT IV ELECTRIC AND HYBRID VEHICLES
Need of electric and hybrid vehicles, propulsion motors and speed control, characteristics of permanent magnet and separately excited DC motors. AC single phase and 3-phase motor, inverters – DC and AC motor speed controllers. Dual system operation, series and parallel hybrid different power series combinations for hybrids; Economy of hybrids; Conventional drive line, clutch elimination. Gearbox elimination, on wheel propulsion. Design considerations and constraints for pure electric and hybrids. Range and speed limitation, structural design aspects, components and system layout design, system integration.

UNIT IV SPECIAL PURPOSE VEHICLES
Constructional features, capacity and stability of jib cranes. Vibratory compactors. Stackers, borewell machines, concrete mixtures. Ride and stability characteristics, power take off, special implementations. Special features and constructional details of tankers, gun carriers and transport vehicles. Harvesting vehicles, ATV.

TEXTBOOK:

1. Irving P.E., “Motor Cycle Engineering”, Temple Press Book, London, 1964.
2. Marshal Cavandedish, ‘Encyclopedia of Motor cycling’, New York, 1989
3. Srinivasan.S., ‘Motor cycle, Scooter, Mobeds’, New century book house, 1988.

REFERENCES:

1. M.M.Griffin., ‘Motor cycles from inside and outside’, Prentice Hall Inc, New Jersey, 1978.
2. Johns.B.A., ‘Motorcycles’, Good Heartwill, 1984.
3. ‘Cycle Motor Manual’, Templeton Press Ltd., London, 1992.
4. Servicing Manuals- various motor cycles, Scooters, Mopeds and three wheelers.
5. Pipenger, ‘Industrial Hydralics’, Mcgraw Hill, Tokoyo, 1979.
6. A. Astakhov, ‘Truck cranes’, MIR Publishers, Moscow, 1971.
7. Bart H Vanderveen, ‘Tanks and Transport Vehicles’, Frederic Warne and co. Ltd., London,
8. K. Abrosimov, A. Bromberg and F. Katayer, ‘Road making machineries’, MIR Pub, Moscow
9. SAE Handbook – Vol III, 1995.

Course contents

Category	Title	Code	Credits-4C			
Elective-I	Automotive Air Conditioning System	MMAE 301 (B)	L	T	P	
			3	1	0	

UNIT I FUNDAMENTALS OF AIR-CONDITIONING, COOLING AND HEATING SYSTEM

Basic terminology, design factors and concepts related to air conditioning system - Construction and Working principles of Thermostatic Expansion valve and Orifice tube based system- Heating system types -detailed study of HVAC components like compressor, evaporator, condenser, TXV, orifice tube , Receiver-drier, heater core etc. Location of air conditioning components in a vehicle.

UNIT II REFRIGERANTS & AIR MANAGEMENT SYSTEMS

Refrigerants:

Temperature and pressure relation, Properties of R-12 and R134a- refrigerant oil Simple problems - Containers - Handling refrigerants - Tapping into the refrigerant container - Ozone Layer Depletion, Air management system: Air routing for manual, semi and automatic system- cases and ducts- Air distribution, control head and doors- Defrost system

UNIT III AUTOMATIC CLIMATE CONTROL SYSTEM

ATC system block diagram- different types of Sensors and Actuators, - Control Logic Electrical wiring diagram of manual and automatic system - multiplexing between BCM and PCM- control of compressor clutch, blower motor etc.- diagnostics tools and features.

UNIT IV MODELING OF AIR-CONDITIONING COMPONENTS

Modeling of Fixed and variable Displacement type compressor, evaporator modeling - heat transfer correlations for the fluids inside the evaporator, analysis of evaporator frosting- condenser modeling - improvement of refrigerant flow control method.

UNIT V AIR CONDITIONING DIAGNOSIS AND SERVICES

AC system diagnosis based on temperature and pressure measurements, sight glass, sound etc. - refrigerant leak detection- Trouble shooting and Servicing of compressor, evaporator, condenser, heater core etc. – HVAC equipment , recovery and charging. Air routing system service.

TEXTBOOK:

1) Tom Birch, “Automotive Heating and Air Conditioning” Pearson Education Inc., 2003.
2) Boyce H. Dwiggins, Jack Erjavec., “Automotive Heating and Air-Conditioning”, Delmer publisher., 2001.
3) William H Crouse and Donald L Anglin, “Automotive air conditioning”, McGraw - Hill Inc., 1990

REFERENCES

1) Goings. L.F., “Automotive air conditioning”, American Technical services, 1974
2) Paul Weiser, “Automotive air conditioning”, Reston Publishing Co Inc., 1990.
3) MacDonald, K.L., “Automotive air conditioning”, Theodore Audel series, 1978.
4) James D. Halderman, “Automotive Heating, Ventilation, and Air Conditioning Systems”, Pearson Education Inc., 2004.
5) SAE papers
6) Vehicle service manuals.

Course contents

Category	Title	Code	Credits-4C			
Elective-II	Aerodynamics & CFD	MMAE 302 (A)	L	T	P	
			3	1	0	

UNIT – I AERODYNAMIC DRAG & SHAPE OPTIMIZATION OF CABS Car as a bluff body – Flow field around car – drag force – types of drag force – analysis of aerodynamic drag – drag coefficient of cars – strategies for aerodynamic development – low drag profiles, Front and modification – front and rear wind shield angle – Boat tailing – Hatch back, fast back and square back – Dust flow patterns at the rear – Effect of gap configuration – effect of fasteners.

UNIT – I I VEHICLE HANDLING

The origin of force and moments on a vehicle – side wind problems – methods to calculate forces and moments – vehicle dynamics Under side winds – the effects of forces and moments – Characteristics of forces and moments – Dirt accumulation on the vehicle – wind noise – drag reduction in commercial vehicles.

UNIT – III WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS

Introduction – Principles of wind tunnel technology – Limitation of simulation – Stress with scale models – full scale wind tunnels – measurement techniques – Equipment and transducers – road testing methods – Numerical methods.

UNIT – IV Mathematical behavior of PDE & impact of CFD

Impact of CFD, Application Areas, Governing equations of fluid dynamics: Introduction, models of the flow, substantial derivative of moving fluid element,

Suitable forms of governing equations, hyperbolic, parabolic, elliptic equations, well posed problems. 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.

UNIT – V CFD Techniques

a) 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.

b) Numerical solution for quasi one dimensional nozzle flow, subsonic, supersonic, isentropic flow and its CFD solution, shock capturing

TEXTBOOK:

1. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 1997.
2. John D. Anderson, “Computational Fluid Dynamics: The Basics with application”,TMH
3. W. Kanzman, Fluids Mechanics

REFERENCES:

1. Pope, A, Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1994.
2. Automotive Aerodynamics: Update SP-706, SAE, 1987.
3. Vehicle Aerodynamics, SP-1145, SAE, 1996.
4. Streeter, “Fluid Mechanics”, Tata McGraw Hill, New Delhi
5. Computational Fluid Flow & Heat Transfer – K. Muralidhar, T. Sundarajan, Narosa Pub. House, New Delhi

Course contents

Category	Title	Code	Credits-4C			
Elective II	Production of Automotive Components	MMAE-302(B)	L	T	P	
			3	1	-	

UNIT I ELASTIC AND PLASTIC BEHAVIOUR OF MATERIALS

Elasticity-forms - Stress and strain relationship in engineering materials - Deformation mechanism - Strengthening material - Strain hardening, alloying, polyphase mixture, martensitic precipitation, dispersion, fibre and texture strengthening - iron carbon diagram.

UNIT II POWDER METALLURGY AND PROCESSING OF PLASTICS

Powder metallurgy process, process variables, Manufacture of friction lining materials for clutches and brakes – plastics-raw material –automobile components – molding – injection, compression and blow – PU foam molding - Machining of plastics.

UNIT III FORGING AND EXTRUSION PROCESS

Forging materials - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, steering column. Extrusions: Basic process steps, extrusion of transmission shaft, housing spindle, steering worm blanks, piston pin and valve tappets. Hydro forming - Process, hydro forming of manifold and comparison with conventional methods- Hydro forming of tail lamp housing – forming of wheel disc and rims. Stretch forming - Process, stretch forming of auto body panels –Super plastic alloys for auto body panels.

UNIT IV CASTING AND MACHINING

Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburetor other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

UNIT V RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS

Powder injection molding - Production of aluminum MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming –Squeeze Casting of pistons - aluminum composite brake rotors. Sinter diffusion bonded idler sprocket – gas injection molding of window channel – cast con process for auto parts.

TEXT BOOK

1. Heldt.P.M., " High Speed Combustion Engines ", Oxford Publishing Co., New York, 1990.
2. High Velocity "Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990
3. Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990.

REFERENCES

1. Rusinoff, " Forging and Forming of metals ", D.B. Taraporevala Son & Co. Pvt Ltd., Mumbai,
2. Sabroff.A.M. & Others, "Forging Materials & Processes ", Reinhold Book Corporation, NY
3. Upton, "Pressure Die Casting ", Pergamon Press, 1985.
4. HMT handbook