Course contents

Category	Title	Code	Credits-4C			
DC1	Finite Element Methods in Automobile Design	MMAE-101	L	T	P	
			3	1	0	

UNIT I Basic Concepts

Basic concepts of finite element method. Steps involved in FEM. Solution of Boundary value problem - Integral formulation for numerical solution - Variational method - Collocation method - Subdomain method - Galerkin method - Least square method - Minimum total potential energy formulation.

UNIT II 1D ELEMENTS

Use of bar and beam elements in structural analysis. Bar Element – Stiffness matrix formulation by direct and polynomial methods. Boundary condition and assemblage concepts. Beam element characteristics matrix. Global, local, natural coordinates - Numerical Integration.

UNIT III 2D ELEMENTS

Rectangular elements - Quadratic quadrilateral elements - Linear Triangular elements - 2D elements applications for plane stress, plane strain and axi-symmetric problems. Numerical integration schemes. Iso Parametric elements

UNIT IV APPLICATION OF FEM

1D & 2D problems in Solid mechanics, fluid mechanics and heat transfer by conduction and convection. Torsion of non circular shaft - axisymmetric problem - acoustic vibration. Dynamics problems representation in FE.

UNIT V FIELD PROBLEM

Case Studies like Structural analysis of Chassis Frame, Heat transfer analysis of piston, fins, Whirling speed of propeller shaft, contact analysis of gears, modal analysis of suspension system etc. FE software package review.

TEXT BOOK:

1. Segerlind,L.J.: Applied Finite Element Analysis: Second Edition, John Wiley Inc., NY,
2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and applications of finite element analysis”, 4th edition, John Wiley & Sons, 2007.

REFERENCES

1. Logan DL; Afirst Course in Finite Element Method;Cengage Learning
2. Gokhle Nitin etal; Practical Finite Element Analysis; Finite to Infinite Pub Pune
3. Krishnamurthy,C.S., Finite Element Analysis, Tata McGraw Hill, 1987.
4. Ramamurthi,V., Computer Aided Design in Mechanical Engineering, Tata McGraw Hill,
5. Bathe,K.J. and Wilson,E.L., Numerical methods in finite element analysis, PHI.
6. J. N. Reddy, “Finite Element Methods”, 2nd Edition, 6th Reprint, Tata McGraw Hill, 2005.
7. Singiresu S. Rao, “The Finite Elements Methods in Engineering”, 4th Edition, USA, 2005.

Course contents

Category	Title	Code	Credits-4C			
DC2	Automotive Engines and Accessories	MMAE-102	L	T	P	
			3	1	0	

UNIT I ENGINE BASIC THEORY

Engine types - operating cycles of SI and CI Engines - Engine design and operating parameters - Two and four stroke engines - Typical performance curves for automobile engines- two stroke engine - performance and pollution aspects.

UNIT II FUEL SUPPLY, IGNITION SYSTEM

Theory of carburetion and carburetors — Design aspects — Petrol Injection and diesel fuel injection - pumps and injectors, gasoline direct injection system - conventional and electronic ignition systems for SI engine.

UNIT III COOLING AND LUBRICATING SYSTEM

Air cooling and water cooling – thermosympon cooling, forced cooling systems. Fins and radiator - design aspects. Theory of lubrication — types of lubrication, splash lubrication system, petroil lubrication system, forced feed lubrication system.

UNIT IV AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS

Premixed combustion, diffused combustion, laminar and turbulent combustion of fuels in engines. Droplet combustion — combustion in SI and CI engines. - Cylinder pressure data and heat release analysis. Optimized design of combustion chambers.

UNIT V NEW ENGINE TECHNOLOGY

Lean Burn engine – Different approaches to lean bum – LHR engine – Surface ignition concept – catalytic ignition – homogenous charge compression ignition in diesel engines – variable valve timing - electronic engine management.

TEXTBOOK

1. J.B.Heywood, ‘Internal combustion engine Fundamentals’, McGraw Hill Book Co, 1989.
2. V.Ganesan, ‘Internal combustion Engines’, Tata McGraw Hill Book Co, Eighth Reprint, 2005.

REFERENCES:

1. Edward F.Obert, ‘Internal combustion engines and air pollution’ Harber and Row Publishers, 1973.
2. M.Khovakh, ’Motor Vehicle Engines’, Mir Publishers, Mascow,1976
3. W.H.Crouse and A.L.Anglin, ‘Automotive Emission control’, McGraw Hill Book Co, 1995.
4. G.S.Springer and A.J.Patterson, ’Engine emissions and pollutant formation’, plenum press, Newyork,1985.

Course contents

Category	Title	Code	Credits-4C			
DC3	Advanced Chassis Design	MMAE-103	L	T	P	
			3	1	0	

UNIT I Frame & Constructional Details

Layout with reference to power plant, steering location and drive, frames, Frameless constructional details, materials, testing of frames, integral body construction.

UNIT II FRONT AXLE STEERING SYSTEM

Front axle type, rigid axle and split axle, Constructional Details, Materials, Front wheel geometry viz., camber, castor, kingpin inclination, toe-in and toe-out. Condition for true rolling motion of road wheels during steering. Steering geometry. Ackermann and Davis steering. Construction details of steering linkages. Different types of steering gear box. Steering linkages layout for conventional and independent suspensions. Turning radius, instantaneous centre, wheel wobble and shimmy. Over-steer and under-steer. Power and power assisted steering

UNIT III DRIVE LINE STUDY

Effect of driving thrust and torque –reaction .Hotchkiss drives. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drive- different types. Two speed rear axle. Rear axle construction-full floating, three quarter floating and semi-floating arrangements. Differential-conventional type, Non-slip type, Differential locks and differential housing.

UNIT IV BRAKING SYSTEM

Type of brakes, Principles of shoe brakes. Constructional details – materials, braking torque developed by leading and trailing shoes. Disc brake, drum brake theory, constructional details, advantages, Brake actuating systems. Factors affecting brake performance, Exhaust brakes, power and power assisted brakes. Testing of brakes.

UNIT V SUSPENSION SYSTEMS

Types of suspension, Factors influencing ride comfort, Types of suspension springs- independent suspension- front and rear. Rubber, pneumatic, hydro- elastic suspension. Shock absorbers. Types of wheels. Construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres, tubeless tyres and aspect ratio of tubed tyres.

TEXT BOOKS:

1. K. Newton, W.Steeds and T.K.Garret, “The Motor Vehicle”, 13th Edition, Butterworth Heinemann, India, 2004.
2. P.M.Heldt, “Automotive Chassis”, Chilton Co., New York, 1982.
3. W.Steed, “Mechanics of Road Vehicles”, Illiffe Books Ltd., London. 1992.

REFERENCES:

1. Harban Singh Rayat, “The Automobile”, S. Chand & Co. Ltd, New Delhi, 2000.
2. G.J.Giles, “Steering Suspension and Tyres”, Illiffe Books Ltd., London, 1975.
3. Kirpal Singh, “Automobile Engineering”, Standard publishers, Distributors, Delhi, 1999.
4. G.B.S.Narang, “Automobile Engineering”, Khanna Pub. New Delhi, 2005.
5. R.P.Sharma, “Automobile Engineering”, Dhanpat Rai & Sons, New Delhi, 2000.

Course contents

Category	Title	Code	Credits-4C			
DC4	Advanced Automotive Transmission	MMAE-104	L	T	P	
			3	1	0	

UNIT I CLUTCH AND GEAR BOX

Requirement of Transmission system. Different types of clutches: Principle, construction and operation of friction clutches. Objective of the gear box. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & power and acceleration. Determination of gear box ratios for different vehicle applications. Different types of gear boxes.

UNIT II HYDRODYNAMIC DRIVES

Principles, performance and limitations of fluid coupling Constructional details of a typical fluid coupling. Reduction of drag torque, Principle, construction and advantages of hydrodynamic torque converters. Performance characteristics, converter couplings. Multi-stage Torque converter and poly phase torque converter.

UNIT III AUTOMATIC TRANSMISSION

Ford – T model gear box, Wilson gear box- Cotal electric transmission– Hydraulic control systems of automatic transmission.

UNIT IV HYDROSTATIC DRIVE AND ELECTRIC DRIVE

Principle of hydrostatic drive systems. Construction and working of typical drives. Advantages and limitations. Control of hydrostatic transmissions, Principle of electric drive. Early and modified Ward Leonard control systems.

UNIT V AUTOMATIC TRANSMISSION APPLICATIONS

Chevrolet “Turboglide” transmission. Toyota’s Automatic transmission with Electronic control system. Continuously Variable Transmission (CVT) – types – Operations.

TEXTBOOK:

1. Heldt P.M, Torque Converters, Chilton Book Co., 1992.
2. K. Newton, W.Steeds and T.K.Garret, “The Motor Vehicle”, 13th Edition, Butterworth Heinemann, India, 2004.

REFERENCES:

1. Heinz Heisler, “Advanced Vehicle Technology”, second edition, Butterworth – Heinemann, New York, 2002
2. Dr. N. K. Giri, “Automobile Mechanics”, Seventh reprint, Khanna Publishers, Delhi, 2005

COURSE CONTENTS

Category	Title	Code	Credits-4C			
DC5	Alternative Fuels & Combustion	MMAE-105	L	T	P	
			3	1	0	

UNIT I ALCOHOLS, NATURAL GAS, LPG, HYDROGEN, BIO-GAS

Properties as engine fuels. Alcohols and gasoline blends. Performance in S.I. engines. Methanol and gasoline blends. Effects of compression ratio. Combustion characteristics in engines. Alcohol diesel emulsions, dual fuel system. Surface ignition engines. Availability of CNG properties. Modification required to use in engine, performance and emission characteristics of CNG. Using LPG in SI and CI engines, performance and emission data for LPG . Hydrogen production methods, storage and handling, performance safety aspects, Various vegetable oils for engines, esterification performance in engines, using biogas in engines, performance and emission characteristics.

UNIT II COMBUSTION STOICHIOMETRY

Combustion equation for hydrocarbon fuels – minimum air required for combustion – excess air supplied, conversion of volumetric analysis to mass analysis. Simulation, advantages of computer simulation, step – by – step approach, reactive processes, heat reaction, measurement of URP, measurement of HRP.

UNIT III ADIABATIC FLAME TEMPERATURE

Introduction, complete combustion C/H/N/O/ systems, constant – volume adiabatic combustion, constant – pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state. SI Engine simulation with air as working medium, deviation between actual and ideal cycle.

UNT IV Combustion & Heat Transfer in IC Engine

Premixed and diffusion combustion process in IC engines and gas turbines. First and Second Law of Thermodynamics applied to combustion- combustion Stoichiometry- chemical equilibrium, spray formation and droplet combustion, Heat transfer and Engine Balance, measurement of Instantaneous heat transfer rate, heat transfer modeling, radiative heat transfer.

UNIT V Chemical Kinetics of Combustion & FLAMES

Fundamentals of combustion kinetics, rate of reaction, equation of Arrhenius, activation energy. Chemical thermodynamic model for Normal Combustion, Laminar premixed – flame speed correlations- quenching, flammability, and ignition, flame stabilization, laminar diffusion flames, turbulent premixed flames-Damkohler number.

TEXTBOOK:

1. Matheswar Dayal, “Energy today & tomorrow”, I &B Horishr India,1982.
2. Brad Ford Bates, Electric Vehicles, SAE, 1992.
3. SAE, Electric and Hybrid vehicles, PT21SAE, Warrendale, 1981.
4. Spalding.D.B., "Some fundamental of Combustion", Butterworth Science Publications, London,
5. Lewis.B., Pease.R.N. and Taylor.H.S., "Combustion Process High Speed Gas Dynamics and Jet Propulsion Series ", Princeton University Press, Princeton, New Jersey, 1976.

REFERENCES

1. Proceeding: vol.II – Tenth International Symposium on Alcohol fuels, The Broad moor Hotel, Coloroda Springs, Colorada.
2. Nagpal,”Power Plant Engineering”, Khanna Publisher,1991.
3. Taylor.E.F. “The Internal Combustion Engines ", International Text Book Co., Pennsylvania,
4. V.Ganesan, ‘Internal combustion Engines’, Tata McGraw Hill Book Co, Eighth Reprint, 2005.
5. Ashley Campbel, “Thermodynamic analysis of combustion engine”, John book co. NY
6. J.l.Ramos, “Modeling of Internal Combustion Engine”, Mcgraw hill book company New york
7. John. B. Heywood,’Internal Combustion Engines'", Tata McGraw Hill Co., Newyork, 1988.
8. Ganesan.V. "Computer Simulation of Spark Ignition Engine Process ", Wiley eastern India ltd

Course contents

Category	Title	Code	Credits-6C			
DC	Lab I FEM & Computer Aided Vehicle Design	MMAE-106	L	T	P	
			0	0	6	

PRACTICAL /LAB WORK

STUDENT IS REQUIRED TO SUBMIT A JOURNAL/REPORT FOR THE SAME

Design calculation, model and analyze the following automobile components

1. Piston, piston pin and piston rings
2. Connecting rod.
3. Automobile valves
4. Crank shaft
5. Cam shaft
6. Vehicle Chassis
7. Leaf spring, coil spring and torsion bar.
8. Front axle system of a typical 4 Wheeled vehicle
9. Rear axle system of a typical 4 wheeled vehicle
10. Three speed and four speed gear boxes of a heavy vehicle

REFERENCES:

1. Dean Averns, " Automobile Chassis Design ", Illiffe Books Ltd, 1992.
2. Richard Stone, “Introduction to Internal Combustion Engines”, McMillan. London, 1985.
3. Bosch, “Automotive HandBook” 6th edition, SAE, 2004.
4. Heldt.P.M., " Automotive Chassis ", Chilton Co., New York, 1992.
5. Steeds.W., " Mechanics of Road vehicles ", Illiffe Books Ltd., London, 1990.
6. Giles.J.G., Steering, " Suspension and tyres ", Illiffe Books Ltd., London, 1988.
7. K. Newton, W.Steeds and T.K.Garret, “The Motor Vehicle”, 13th Edition, Butterworth Heinemann, India, 2004.
8. Heldt.P.M., " Torque converter ", Chilton Book Co., New York, 1982.
9. Dr. N. K. Giri, “Automobile Mechanics”, Seventh reprint, Khanna Publishers, Delhi, 2005
10. ACAD, CATIA and ANSYS software guide / manual

Course contents

Category	Title	Code	Credits-6C			
DC	Lab II Engine and Chassis	MMAE-107	L	T	P	
			0	0	6	

PRACTICAL /LAB WORK

STUDENT IS REQUIRED TO SUBMIT A JOURNAL/REPORT FOR THE SAME

1. Performance Test of SI Engine.
2. Performance Test of CI Engine.
3. Determination of pressure crank angle diagram in IC Engines.
4. Heat balance test on IC engines
5. Performance test on variable compression ratio multi fuel diesel engine.
6. Assembling and dismantling of the following
   (i) SI-Hyundai engine.
   (ii) CI-Ashok Leyland engine
   (iii) V-8 Ford engine
   (iv) Single plate, Diaphragm Clutch.
   (v) Constant mesh , Sliding mesh gear box
   (vi)Transfer case
   (vii)Differential
   (viii)Front axle, Rear axle
   (ix) Brakes system
   (x) Steering system

REFERENCES:

1 K. Newton, W.Steeds and T.K.Garret, “The Motor Vehicle”, 13th Edition, Butterworth Heinemann, India, 2004.
2 P.M.Heldt, “Automotive Chassis”, Chilton Co., New York, 1982.
3 W.Steed, “Mechanics of Road Vehicles”, Illiffe Books Ltd., London. 1992.
4 Harban Singh Rayat, “The Automobile”, S. Chand & Co. Ltd, New Delhi, 2000.
5 G.J.Giles, “Steering Suspension and Tyres”, Illiffe Books Ltd., London, 1975.
6 Kirpal Singh, “Automobile Engineering”, Standard publishers, Distributors, Delhi, 1999.
7 G.B.S.Narang, “Automobile Engineering”, Khanna Publishers, Twelfth reprint New Delhi, 2005.
8 R.P.Sharma, “Automobile Engineering”, Dhanpat Rai & Sons, New Delhi, 2000.