

ANNA UNIVERSITY COIMBATORE- 641 013

B.E. AUTOMOBILE ENGINEERING CURRICULUM

SEMESTER – IV

CODE NO.	COURSE TITLE	L	T	P	M	C
<b>THEORY</b>						
07MA401	NUMERICAL METHODS (Common With Mechanical)	3	1	0	100	4
07AT401	AUTOMOTIVE DIESEL ENGINES	3	0	0	100	3
07AT402	AUTOMOTIVE CHASSIS	3	0	0	100	3
07ME402	MECHANICS OF MATERIALS (Common With Mechanical)	3	1	0	100	4
07AT403	MECHANICS OF MACHINES	4	1	0	100	5
07ME303	ENGINEERING METALLURGY (Common With Mechanical)	3	0	0	100	3
<b>PRACTICAL</b>						
07AT4L1	AUTOMOTIVE CHASSIS COMPONENTS LAB	0	0	3	100	1.5
07ME4L2	MATERIAL TESTING LAB (Common With Mechanical)	0	0	3	100	1.5
07AT4L3	AUTOMOTIVE ENGINE COMPONENTS LABORATORY	0	0	3	100	1.5

**TOTAL : 45**

## 07MA401 NUMERICAL METHODS

(Common to Mechanical, Production, Automobile, Aeronautics)

3 1 0 100

### 1. SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9

Solution of Algebraic and Transcendental equations by Iteration method, method of False position and Newton's method – Solution of linear system of equations by Gauss elimination, Gauss Jordan, Gauss Seidal and Relaxation methods– Inverse of a matrix by Gauss Jordan method - Eigen value of a matrix by Power method and Jacobi method.

### 2. INTERPOLATION 9

Definition of operators -  $\Delta, \nabla, \delta, \mu$  and E. Newton's forward and backward difference formulas. Newtons Divided differences, Lagrange's polynomials – Interpolation with a cubic spline

### 3. NUMERICAL DIFFERENTIATION AND INTEGRATION 9

Numerical Differentiation with Newtons forward and Backward difference formula – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Double integrals using Trapezoidal and Simpson's rules.

### 4. INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9

Single step methods: Taylor's series method – Euler and Modified Euler method – Fourth order Runge Kutta method for solving first and second order equations – Multi step methods : Milne's and Adam's predictor and corrector methods.

### 5. BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimension heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

**TUTORIALS: 15**

**TOTAL: 60**

## REFERENCES

1. Veerarajan.T and Ramachandran T “Numerical Methods, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007
2. Venkatraman M. K. “Numerical Methods” National Publishing Company-2003
3. Kandasamy, P.Thilakavthy, K and Gunavathy, K. “Numerical Methods”, S.Chand and Co. New Delhi.1999
4. Balagurusamy E. “Numerical Methods” , Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1999
5. Gerald C.F. and Wheatley P.O. – “ Applied Numerical Analysis”, Pearson, 2004.
6. Burden R.L. and Faires J.D. “Numerical Analysis”, Brooks Cole, Eighth Edition, 2004

## **07AT401 AUTOMOTIVE DIESEL ENGINES**

**3 0 0 100**

### **1. BASIC THEORY**

**9**

Diesel engine construction and operation, two stroke and four stroke diesel dual cycle engines, diesel cycle, fuel-air and actual cycle analysis, diesel fuel, ignition quality, cetane number, laboratory tests for diesel fuels, standards and specifications.

### **2. FUEL INJECTION SYSTEM**

**9**

Requirements, air and solid injection, functions of components, jerk and distributor type pumps - common rail injection system, PTFI system pressure waves, injection lag, unit injector, mechanical and pneumatic governors, fuel injector, types of injection nozzle, nozzle tests, spray characteristics, injection timing, pump calibration.

### **3. AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS**

**9**

Importance of air motion, swirl, squish and turbulence, swirl ratio, fuel air mixing, stages of combustion, delay period, factors affecting delay period, knock in CI engines. Combustion chamber: design requirements, direct and indirect injection combustion chambers, M type combustion chamber.

### **4. SUPERCHARGING AND TURBOCHARGING**

**9**

Necessity and limitations, types of supercharging and turbo charging, relative merits, matching of turbocharger, exhaust gas recirculation, charge cooling.

### **5. DIESEL ENGINE TESTING AND PERFORMANCE**

**9**

Automotive and stationary diesel engine testing and related emission standards. Engine performance and emission characteristics, variables affecting engine performance and emission, methods to improve engine performance, heat balance, performance maps. Preventive maintenance of diesel engines.

**TOTAL : 45**

## **REFERENCES**

1. Ganesan.V "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. M.L.Mathur and R. P.Sharma "A course in Internal Combustion Engines", Dhanpat Rai and Sons, 2002.
3. Dr.K.K.Ramalingam "Internal Combustion Engines Theory and Practice", Scitech Publications (India) Pvt. Ltd., Chennai 600 017, 2002.
4. Heywood.J.B "Internal Combustion Engine Fundamentals", McGraw-Hill Book Co., 1988.
5. Heinz Heister "Advanced Engine Technology", SAE, 1995.
6. Pulkrabek "Engineering Fundamentals of the Internal Combustion Engines", Practice Hall of India, 2003.

## **07AT402 AUTOMOTIVE CHASSIS**

**3 0 0 100**

### **1. INTRODUCTION**

**8**

Types of chassis layout with reference to power plant locations and drives, vehicle frames, various types of frames, constructional details, materials, testing of vehicle frames, unitized frame body construction.

### **2. FRONT AXLE AND STEERING SYSTEM**

**10**

Types of front axles, construction details, materials, front wheel geometry: castor, camber, king pin inclination, toe-in. conditions for true rolling motion of wheels during steering, steering geometry, Ackermann and Davis steering system, constructional details of steering linkages, different types of steering gear boxes, steering linkages and layouts, turning radius, wheel wobble, power assisted steering, steering of crawler tractors.

### **3. DRIVE LINE**

**10**

Effect of driving thrust and torque reactions, Hotchkiss drive, torque tube drive and radius rods, propeller shaft, universal joints, front wheel drive, different types of final drive, double reduction and twin speed final drives, differential principle, construction details of differential unit, non-slip differential, differential locks, differential housings, construction of rear axles, types of loads acting on rear axles, fully floating, three quarter floating and semi floating rear axles, rear axle housing, construction of different types of axle housings, multi axle vehicles.

### **4. SUSPENSION SYSTEM**

**8**

Need of suspension system, types of suspension, suspension springs, constructional details and characteristics of leaf, coil and torsion bar springs, independent suspension, rubber suspension, pneumatic suspension, shock absorbers.

### **5. BRAKING SYSTEM**

**9**

Classification of brakes, drum brakes and disc brakes, constructional details, theory of braking, concept of dual brake system, parking brake, material, hydraulic system, vacuum assisted system, air brake system, antilock braking, retarded engine brakes, eddy retarders.

**TOTAL : 45**

## **REFERENCES**

1. Newton, Steeds and Garrot- "Motor Vehicles"- Butterworths, London- 2000.
2. Heldt.P.M.- "Automotive Chassis"- Chilton Co., New York- 1990
3. Giles.J.G- "Steering, Suspension and tyres"- Iliffe Book Co., London- 1988.
4. Crouse W.H- "Automotive Chassis and Body"- McGraw-Hill, New York- 1971.
5. K.K.Ramalingam - "Automobile Engineering" – Scitech Publication, Chennai - 2001.
6. Steed W - "Mechanics of Road Vehicles"- Iliffe Books Ltd., London- 1960

## **07ME402 MECHANICS OF MATERIALS**

(Common to Mechanical and Automobile)

**3 1 0 100**

### **1. STRESS, STRAIN AND DEFORMATION OF SOLIDS**

**9**

Rigid and deformable bodies – Stability, strength and stiffness- Tensile, compressive and shear stresses, strain- Poisson's ratio- lateral stress- Deformation of simple and compound bars- Relation between elastic constants- Thermal stresses. Strain Energy in uniaxial loads- gradually applied load, suddenly applied load and impact load.

### **2. TRANVERSE LOADING ON BEAMS AND STRESSES IN BEAMS**

**9**

Beams – types and transverse loading on beams- shear force and bending moment in beams- cantilevers, simply supported and over hanging beams- Point of contra flexures. Theory of simple bending – analysis of stress – load carrying capacity. Shear stress distribution of simple beams - circular, rectangular, “I” section, “T” section and channel sections.

### **3. DEFLECTION OF BEAMS AND COLUMNS**

**9**

Elastic curve of neutral axis of the beam under normal loads-Evaluation of beam deflection and slope: Double Integration method – Macaulay's method- Moment area method.

Columns: End condition – Equivalent length of a column – Euler's Equation- Slenderness ratio- Rankine formula for columns.

### **4. ANALYSIS OF STATE OF STRESS (TWO DIMENSIONAL)**

**9**

Biaxial state of stress – Thin cylinders and shells – Deformation in thin cylinders and spherical shells- Biaxial Stresses at a point – Stresses on inclined planes- Principal planes and stresses – Mohr's Circle for biaxial stress. Maximum shear stress.

### **5. TORSION**

**9**

Torsion of Circular shaft- Shear stress distribution- hollow and solid circular section, torsional rigidity – stepped shaft- Twist and torsional stiffness- Compound shafts-shafts fixed at both ends and simply supported..

Torsion on springs – Wahl's factor of spring - Stresses in helical springs under torsion loads- Stiffness and deflection of springs under axial load.

**TUTORIALS: 15    TOTAL: 60**

## REFERENCES

1. James M.Gere, Mechanics of Materials, Brooks/Cole Thomson Learning, 5<sup>th</sup> edn., 2001
2. Popov.E.P.,” Engineering Mechanics of Solids”, Prentice- Hall of India, New Delhi.
3. Beer F.P, and Johnston R, “Mechanics of Materials “, McGraw- Hill Book Co, Third Edition.
4. Timoshenko S.P., “Elements of Strength of Materials “,Tata McGraw – Hill New Delhi
5. Nash W.A., “Theory and Problems in Strength of Materials“, Schaum outline Series, McGraw – Hill Book Co., New York.
6. Rajput.R.K.,“Strength of Materials”, S.Chand & Co, Third Edition , 2003

**1. MECHANISMS**

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

**2. FRICTION**

9

Friction in screw and nut – Pivot and collar – Thrust bearing– Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive – Plate and disc clutches.

**3. FORCE ANALYSIS**

10

Applied and constraint forces-static equilibrium conditions-two, three force members-rigid body dynamics in general plane motion – equations of motion - dynamic force analysis - inertia force and inertia torque – D’Alemberts principle - the principle of superposition - dynamic analysis in reciprocating engines – gas forces - equivalent masses - bearing loads - crank shaft torque - turning moment diagrams - fly wheels .

**4. BALANCING**

10

Static and dynamic balancing – Single and several masses in different planes – Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method.

**5. CONTROL MECHANISMS**

8

Governors - types - centrifugal governors - gravity controlled and spring controlled centrifugal governors characteristics – stability- sensitiveness-hunting, isochronisms - effect of friction - controlling force Gyroscopes - gyroscopic forces and torques - gyroscopic stabilization - gyroscopic effects in automobiles, ships and airplanes

**6. GEARING AND CAMS**

10

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicyclic gear trains - Determination of speed and torque - Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with offset and without offset for various types of follower motions.

**TUTORIALS: 15 TOTAL: 75**

## REFERENCES

1. Rattan.S.S, "Theory of Machines", Tata McGraw–Hill Publishing Co., New Delhi, 2004.
2. Ballaney.P.L, "Theory of Machines", Khanna Publishers, New Delhi, 2002.
3. Rao,J.S and Dukupati, R.V, "Mechanism and Machine Theory", Second Edition, Wiley Eastern Ltd., 1992.
4. Malhotra, D.R and Gupta, H.C., "The Theory of Machines", Satya Prakasam, Tech. India Publications, 1989.
5. Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press, 1989.
6. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill, 1980.

**1. CRYSTAL STRUCTURE – A REVIEW:**

**(3)**

BCC, FCC and HCP structure- unit cell –crystallographic planes and directions, miller indices-crystal imperfections, point, line, planar and volume defects – Grain size, Grain boundary - ASTM grain size number.

**2. ALLOYS AND PHASE DIAGRAMS:**

**(9)**

Constitution of alloys – solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron - Iron carbide equilibrium diagram. Classification of steel and cast iron microstructure, properties and applications.

**3. HEAT TREATMENT:**

**(9)**

Definition – Full annealing, stress relief, recrystallisation and spheroidizing – normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – Continuous Cooling - Transformation Curves – Critical Cooling Rate - Hardenability, Jominy end quench test – Austempering, martempering- case hardening, carburizing, nitriding, cyaniding, carbo-nitriding - Flame and Induction hardening

**4. FERROUS AND NON FERROUS MATERIALS**

**(8)**

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) – stainless steel and tool steels – HSLA- maraging steels – Gray, White malleable, spheroidal – Graphite – alloy castings.

Copper, Aluminum, Nickel, Magnesium, Titanium, Lead C Tin and Important alloys. Their composition properties and applications.

**5. MECHANICAL PROPERTIES AND TESTING OF MATERIALS:**

**(9)**

Mechanical properties of engineering materials - Mechanisms of plastic deformation, slip and twinning – Creep, Fatigue and Fracture - Types of fracture – Testing of materials under tension, compression and shear loads - fatigue and creep tests – hardness and its effects – testing for hardness (Brinell, Vickers and Rockwell) - Impact test - Izod and Charpy.

**6. NON DESTRUCTIVE TESTING:**

**(4)**

Non Destructive Testing basic principles and testing method for Radiographic Testing, Ultrasonic testing, Magnetic Particle Inspection and Liquid Penetrant Inspections.

**7. SELECTION OF MATERIALS:**

**(3)**

Factors to be considered while selecting a material, with specific examples

**Total : 45**

**REFERENCES:**

1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4<sup>th</sup> Indian Reprint 2002
2. William D. Callister, "Material Science and Engineering", John Wiley and Sons 1997.
3. Raghavan V, "Materials Science and Engineering", Prentice Hall of India Pvt Ltd., 1999.
4. Sydney H. Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994
5. Aswani K. G., "A Text Book of Material Science", S. Chand & Co. Ltd., New Delhi, 2001.

**LIST OF EXPERIMENTS**

**Study and measurement of the following chassis frames:**

1. Heavy duty vehicle frame (Leyland, Tata etc)
2. Light duty vehicle frame (Ambassador, Maruti van etc)

**Study, dismantling and assembling of**

3. Front Axle
4. Rear Axle
5. Differential
6. Steering systems along with any two types of steering gear box
7. Braking systems – hydraulic servo vacuum, compressed air power brakes.
8. Leaf spring, coil spring, torsion bar spring, Hydraulic shock absorber

***Study, Dismantling and Assembling of***

9. Clutch assembly of different types
10. Gear Box
11. Transfer case

TOTAL : 45

**MATERIALS TESTING LAB**  
(Common to Mechanical and Automobile)

**0 0 3 100**

**LIST OF EXPERIMENTS**

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen (Izod and Charpy Test )
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using strain gauge
9. Fatigue testing
10. Effect of hardening – Improvement in hardness and impact resistance of steels.
11. Effect of tempering - Improvement in mechanical properties.
12. Microstructure examination of samples.

**TOTAL : 45**

1.    Dismantling of 4 cylinder petrol engine.
2.    Assembling of 4 cylinder petrol engine.
3.    Dismantling of 6 cylinder diesel engine.
4.    Assembling of 6 cylinder diesel engine.
5.    Study of oil filter, fuel filter, fuel injection system, carburetor, MPFI
6.    Study of ignition system components – coil, magneto and electronic ignition systems.
7.    Study of engine cooling system components
8.    Study of engine lubrication system components
9.    Ovality and taper measurement of cylinder bore and comparison with standard specifications
10.    Ovality and taper measurement of engine crank shaft and comparison with standard specification

**TOTAL : 45**