

**ANNA UNIVERSITY COIMBATORE**  
**REGULATIONS 2007**  
**B.E. AUTOMOBILE ENGINEERING**

**SEMESTER – V**

Code No.	Course Title	L	T	P	M	C
<b>THEORY</b>						
	AUTOMOTIVE TRANSMISSIONS	3	0	0	100	3
	FUEL AND LUBRICANTS	3	0	0	100	3
	AUTOMOTIVE ELECTRICAL AND ELECTRONICS	3	0	0	100	3
	MECHANICAL DESIGN	3	2	0	100	4
	DYNAMICS OF MACHINERY	3	1	0	100	4
	HYDRAULIC & PNEUMATIC SYSTEMS	3	0	0	100	3
<b>PRACTICALS</b>						
	FUELS AND ENGINE TESTING LAB	0	0	3	100	1.5
	AUTOMOTIVE ELECTRICAL AND ELECTRONICS LAB	0	0	3	100	1.5
	KINEMATICS AND DYNAMICS LAB	0	0	3	100	1.5
	Total	18	3	9	900	

**SEMESTER-VI**

Code no.	Course title	L	T	P	M	C
<b>THEORY</b>						
	FINITE ELEMENT ANALYSIS (Common to Mechanical and Automobile Engineering)	3	2	0	100	4
	DESIGN OF CHASSIS AND CHASSIS SYSTEMS	3	1	0	100	4
	IC ENGINE DESIGN	3	1	0	100	4
	VEHICLE DYNAMICS	3	1	0	100	4
	TRANSPORT MANAGEMENT	3	0	0	100	3
	ENGINEERING ECONOMICS & FINANCE (Common to Mechanical and Automobile Engineering)	3	0	0	100	3
<b>PRACTICALS</b>						
	VEHICLE PERFORMANCE CHARACTERISTICS LAB	2	2	0	100	3
	SIMULATION & ANALYSIS LABORATORY	0	0	3	100	1.5
	VEHICLE MAINTENANCE LABORATORY AND MINI PROJECT	0		3	100	1.5
		0	0	4	100	2

<b>AUTOMOTIVE TRANSMISSION</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>3</b>	
<b>UNIT I</b>	<b>CLUTCH</b>					<b>7</b>	
Role - positive and gradually engaged types - types of clutches, single plate clutch, coil spring type and diaphragm spring type, multiple plate clutch, centrifugal clutch, calculation of torque transmission, over running clutch.							
<b>UNIT II</b>	<b>GEAR BOX AND AUTOMATIC TRANSMISSION</b>					<b>11</b>	
Need for a gearbox, types of gear boxes, sliding mesh, constant mesh and synchromesh gear boxes, calculation of gear ratios, epicyclical gearboxes, overdrives, transfer case - auxiliary gearbox, gear shifting mechanisms. Need for fluid coupling and torque converters, Borg Warner type, control mechanisms, limitations. Transmission Electronics, Automatic Manual Transmission.							
<b>UNIT III</b>	<b>DRIVE LINE AND AXLES:</b>					<b>11</b>	
Chain drive, propeller shaft drive, torque reaction and drive thrust , Hotchkiss drive, Torque tube drive, universal joints, trunnion type, ring type, flexible disc type, constant velocity joint type, swinging arm drives. Live and dead axles, front axle and its types, stub axle and its types, rear axle and its types, fully floating, semi- floating and three quarter floating axles, two speed axles, twin axles, swing axles							
<b>UNIT IV</b>	<b>FINAL DRIVE AND DIFFERENTIAL:</b>					<b>7</b>	
Need for final drive and differential, types of final drives, single reduction and double reduction final drives, differential and its types, conventional and non-slip differentials, differential lock, Inter axle differential transaxle types.							
<b>UNIT V</b>	<b>HYDROSTATIC DRIVES AND ELECTRICAL DRIVES</b>					<b>9</b>	
Advantages and disadvantages –principles of hydrostatic drive systems, construction and working of typical hydrostatic drives, Advantages and limitations -principles of ward Leonard system of control , modern electric drives for buses and performance characteristics.							
					<b>Lecture</b>	<b>:</b>	<b>45</b>
					<b>TUTORIAL</b>	<b>:</b>	<b>-</b>
					<b>TOTAL</b>	<b>:</b>	<b>45</b>
<b>REFERENCES:</b>							
1.	Newton and Steeds, " Motor vehicles ", Illiffe Publishers, 1985.						
2.	Gupta.K.M., "Automobile Engineering", Umesh Publications, New Delhi, 2001						
2	Heldt.P.M., " Torque converters ", Chilton Book Co., 1992.						
3	Judge.A.W., " Modern Transmission systems ", Chapman and Hall Ltd., 1990.						
4	Crouse. W.H., Anglin., D.L., " Automotive Transmission and Power Trains construction"						
5	"Hydrostatic transmissions for vehicle applications ", I Mech E Conference, 1981-88.						
6	SAE Transactions 900550 & 930910.						

<b>FUELS AND LUBRICANTS</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>3</b>
<b>UNIT I</b>	<b>COMBUSTION AND FUEL RATING</b>					<b>9</b>
SI engine and flame propagation and mechanism of combustion – normal combustion – knocking-octane rating –fuel requirements. CI engine and mechanism of combustion – diesel detonation-octane rating –fuel requirements. Additive –mechanism, requirements of an additive , petrol and diesel fuel additives-specification of fuels						
<b>UNIT II</b>	<b>PROPERTIES AND TESTING OF FUELS :</b>					<b>9</b>
Thermo-chemistry of fuels-properties and testing of fuels- relative density- calorific value and distillation - vapor pressure - flash point - fire point - aniline point - viscosity – pour point – flammability – ignitability - diesel index – API gravity.						
<b>UNIT III</b>	<b>THEORY OF LUBRICATION AND LUBRICANTS</b>					<b>9</b>
Engine friction fundamentals-influence of engine variable on friction - hydrodynamic and elasto hydrodynamic lubrication-boundary lubrication-bearing lubrication - functions of the lubrication system – basics of lubrication design system						
<b>UNIT IV</b>	<b>ALCOHOLS AND GASEOUS FUELS</b>					<b>11</b>
Various alcohols as fuels. Performance in SI and CI engines, methanol and gasoline blends, combustion characteristics and emission characteristics. Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG and LPG						
<b>UNIT V</b>	<b>BIO-FUELS:</b>					<b>7</b>
Various vegetable oils for engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics.						
					<b>LECTURE</b>	<b>: 45</b>
					<b>TUTORIAL</b>	<b>: -</b>
					<b>TOTAL</b>	<b>: 45</b>
<b>Text Books</b>						
1. Richard L.Bechfold, “Alternative Fuels Guide Book”, SAE International, Warrendale, 1997. 2. “Automobiles and pollution” SAE Transaction, 1995.						
<b>REFERENCES:</b>						
1.	“Alcohols as motor fuels progress in technology”, Series No.19, SAE Publication, USA, 1980.“Proceedings of the International Conference on Automotive and Fuel Technology”, SAE INDIA, 2004					

<b>AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>3</b>
<b>UNIT I</b>	<b>BATTERIES</b>					<b>5</b>
Lead acid and alkaline batteries, battery rating, battery testing and maintenance.						
<b>UNIT II</b>	<b>STARTING SYSTEM AND CHARGING SYSTEM:</b>					<b>9</b>
Principle and construction of starter motor, working of different starter drive units. DC and AC Generators – principle, construction and working, cut-outs and regulators, charge balancing						
<b>UNIT III</b>	<b>LIGHTING SYSTEM:</b>					<b>9</b>
Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Horn, wiper system and trafficator. Multiplexing and de-multiplexing, fuses, cables, connectors and selection						
<b>UNIT IV</b>	<b>SENSORS AND ACTUATORS:</b>					<b>10</b>
Classification of sensors, sensors for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors and relay.						
<b>UNIT V</b>	<b>AUTOMOTIVE CONTROL SYSTEM</b>					<b>12</b>
Basics – open loop – closed loop- transfer function –stability of a system-bode plot-pneumatic and hydraulic control system- sliding mode- PID controls-Concept of an electronic engine control system, gasoline direct injection, electronic ignition control, engine mapping, on-board diagnostics – engine control module and power-train control module						
					<b>Lecture</b>	<b>: 45</b>
					<b>TUTORIAL</b>	<b>: -</b>
					<b>TOTAL</b>	<b>: 45</b>
<b>Textb Books</b>						
1. Crouse W H, "Automobile Electrical Equipment" , McGraw Hill Book Co., Inc., New York 3 <sup>rd</sup> edition,1986.						
2. William B Riddens, "Understanding Automotive Electronics", 5 <sup>th</sup> edition, Butter worth Heinemann Woburn, 1998.						
<b>REFERENCES:</b>						
1.	Bechhold "Understanding Automotive Electronics" SAE, 1998.					
2	Judge A W, "Modern Electrical Equipment of Automobiles", Chapman & Hall, London,1992.					
3	Robert Bosch, "Automotive Hand Book" SAE, 5 <sup>th</sup> edition, 2000.					
4	Kholi P L, "Automotive Electrical Equipment", Tata McGraw Hill Co., Ltd., New Delhi, 1975.					

<b>MECHANICAL DESIGN</b>		<b>3</b>	<b>2</b>	<b>0</b>	<b>100</b>	<b>4</b>
<b>UNIT I</b>	<b>Fundamentals of Design</b>					<b>8</b>
Principles of Mechanical Engineering design, Aesthetic and Ergonomic considerations in design, Standardizations, selection of material, mechanical properties of material, Limits, Fits and Tolerances - factor of safety, theories of failure. Fluctuating stresses, endurance limit, endurance strength, Modifying factors, stress concentration, causes and remedies, notch sensitivity, design for finite and infinite life under reverse stresses, cumulative damage in fatigue failure, Soderberg & Goodman diagram, Modified Goodman diagram fatigue design for component such as shaft, bolted joints & springs under combined stresses						
<b>UNIT II</b>	<b>Design of shaft, keys and coupling</b>					<b>10</b>
Shafts: Introduction, types of shafts, design of shafts subjected to twisting moments, bending moments, combined twisting and bending moments. Shaft design for fatigue loads - Keys - types of keys, design of keys, Coupling - Design of rigid coupling & design of flexible coupling.						
<b>UNIT III</b>	<b>Design of Springs and Levers</b>					<b>10</b>
Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs - Belleville springs – Design of Levers						
<b>UNIT IV</b>	<b>Selection of Belts, Chains and Bearings</b>					<b>10</b>
Belts – types and applications – Selection of V belts – Chains – types and applications – Selection of roller chains - Bearings – Need - sliding contact and rolling contact types – types and applications - Cubic mean load – Selection of ball and roller bearings - Design of journal bearings – Mckees equation – Lubrication in journal bearings – calculation of bearing dimensions.						
<b>UNIT V</b>	<b>Design of bolted joints and Power screws</b>					<b>8</b>
Mechanical Joints – Riveted, welded and bolted joints – types and applications - Design of bolted joints – Self locking of screw threads - Design of power screws – selection of recirculating ball screw.						
					<b>LECTURE</b>	<b>: 46</b>
					<b>TUTORIAL</b>	<b>: 30</b>
					<b>TOTAL</b>	<b>: 76</b>
<b>REFERENCES:</b>						
1.	Shigley J.E. and Mischke C.R., “Mechanical Engineering Design”, McGraw Hill Publication Co. Ltd.					
2.	Spotts M.F., Shoup T.E “Design and Machine Elements” Pearson Education, 2004.					
3.	Bhandari V.B., “Design of Machine Elements”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2007					
4.	Black P.H. and O. Eugene Adams, “Machine Design” , McGraw Hill Book Co. Inc.					
5.	William C. Orthwein, “Machine Components Design”, West Publishing Co. and Jaico Publications House. 2003					
6.	Hall A.S., Holowenko A.R. and Laughlin H.G., “Theory and Problems of Machine Design”, Schaum’s Outline Series.					
7.	Juvinal R.C., “Fundamentals of Machine Components Design”, John Wiley and Sons.					
8.	Design Data”, P.S.G. College of Technology, Coimbatore.					

<b>DYNAMICS OF MACHINERY</b> ( Common for Mechanical and Automobile Engineering )		<b>3</b>	<b>2</b>	<b>0</b>	<b>100</b>	<b>5</b>
<b>UNIT I</b>	<b>FORCE ANALYSIS</b>					<b>9</b>
Applied and constraint forces-static equilibrium conditions-two, three force members – 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 – Coefficient of fluctuation of energy and speed Weight of flywheel required						
<b>UNIT II</b>	<b>BALANCING</b>					<b>9</b>
Static and dynamic balancing - balancing of rotating masses - balancing of single and multi-cylinder engines - balancing of reciprocating masses- partial balancing in locomotive engines - balancing linkages - balancing machines-inline and V-engines						
<b>UNIT III</b>	<b>CONTROL MECHANISMS</b>					<b>9</b>
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						
<b>UNIT IV</b>	<b>LONGITUDINAL VIBRATION</b>					<b>9</b>
Undamped free vibration of single degree of freedom system- simple pendulum, compound pendulum -springs in series, springs in parallel and combinations. Damped free vibration of single degree of freedom system, types of damping-viscous damping, critically damped, under damped system. Logarithmic decrement. Forced vibration of single degree of freedom system-constant harmonic excitation, steady state vibration, magnification factor, vibration isolation and transmissibility.						
<b>UNIT V</b>	<b>TRANSVERSE AND TORSIONAL VIBRATIONS</b>					<b>9</b>
Transverse vibrations of beams-natural frequency- energy method - Dunkerly”s method. critical speed –whirling of shafts. Torsional systems- natural frequency of two and three rotor systems, equivalent shafts, geared systems, Holzer’s method, Signature Analysis.						
					<b>LECTURE</b>	<b>: 45</b>
					<b>TUTORIAL</b>	<b>: 15</b>
					<b>TOTAL</b>	<b>: 60</b>
<b>REFERENCES</b>						
1	Rattan S.S, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.					
2	Rao J.S and Dukkipati R.V, “Mechanism and Machine Theory”, New Age International, New Delhi, 2007.					
3	Thomas Bevan, “Theory of Machines” CBS Publishers and Distributers, 1984.					
4	Ballaney.P.L ”Theory of Machines”, Khanna Publishers,1990.					
5	Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.					
6	Sadhu Singh “Theory of Machines”, Pearson Education, 2002.					
7	Rao J.S and Gupta.K,“Introduction course on theory and practice of Mechanical Vibrations”, Second edition, New Age International Publishers, 1999.					

	<b>HYDRAULICS AND PNEUMATIC SYSTEMS</b> ( Common for Mechanical and Automobile Engineering )	<b>3</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>3</b>
<b>UNIT I</b>	<b>FLUID POWER SYSTEMS AND FUNDAMENTALS</b>					<b>9</b>
<p>Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols.</p> <p>Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow – Reynold’s number – Darcy’s equation – Losses in pipe, valves and fittings.</p>						
<b>UNIT II</b>	<b>HYDRAULIC SYSTEM AND COMPONENTS</b>					<b>9</b>
<p>Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps.</p> <p>Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tandem, Rod less, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.</p>						
<b>UNIT III</b>	<b>DESIGN OF HYDRAULIC CIRCUITS</b>					<b>9</b>
<p>Construction of Control Components : Director control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram.</p> <p>Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.</p>						
<b>UNIT IV</b>	<b>PNEUMATIC SYSTEMS AND COMPONENTS</b>					<b>9</b>
<p>Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators.</p> <p>Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Penumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.</p>						
<b>UNIT V</b>	<b>DESIGN OF PNEUMATIC CIRCUITS</b>					<b>9</b>
<p>Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves.</p> <p>Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.</p>						
					<b>LECTURE</b>	<b>: 45</b>
					<b>TUTORIAL</b>	<b>: 0</b>
					<b>TOTAL</b>	<b>: 45</b>

<b>TEXT BOOKS</b>	
1	Anthony Esposito, "Fluid Power with Applications", Pearson Education 2000
2	Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.
<b>REFERENCES</b>	
1	Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
2	Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
3	Harry L. Stevart D.B, "Practical guide to fluid power", Taraoeala sons and Port Ltd. Broadey, 1976
4	Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
5	Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

## PRACTICALS

<b>FUELS AND ENGINE TESTING LAB</b>	
<b>S.No</b>	<b>NAME OF THE EXPERIMENT</b>
1	Lubricant viscosity tests
2	Determination of flash and fire point
3	Aniline point tester
4	Pour point tester
5	Study of IC engine testing Dynamometers.
6	Valve timing and port timing diagram
7	Performance study of petrol engine.
8	Performance study of diesel engine.
9	Performance study of LPG engine
10	Morse test on petrol engines.
11	Heat balance test on multi cylinder engine.
12	Engine tuning for performance improvement
	Mechanical and electrical system trouble shooting
<b>Text Book:</b>	
1. Giles.J.G., " Vehicle Operation and performance ", Iliffe Books Ltd., London, 1989.	
<b>REFERENCE:</b>	
1	Crouse.W.H. and Anglin.D.L., " Motor Vehicle Inspection " McGraw Hill Book Co., 1978.
2	Ganesan.V., " Internal Combustion engines ", Tata McGraw Hill Co., 1994.
3	BIS Code Books. IS-10000 series, 1988

<b>ELECTRICAL AND ELECTRONICS LAB</b>	
<b>ELECTRICAL LABORATORY EXPERIMENTS</b>	
1	Testing of batteries and battery maintenance
2	Testing of starting motors and generators
3	Testing of regulators and cut – outs
4	Diagnosis of ignition system faults
5	Study of Automobile electrical wiring.
<b>ELECTRONICS LABORATORY</b>	
6	Study of rectifiers and filters
7	Study of logic gates, adder and flip-flop
8	Study of SCR and IC timer
9	Interfacing A/D converter and simple data acquisition
10	Micro controller programming and interfacing

<b>KINEMATICS AND DYNAMICS LAB</b>	
<b>S.No</b>	<b>KINEMATICS - EXPERIMENTS</b>
1	Kinematics of four bar mechanisms - Slider Crank, Crank Rocker Mechanism.
2	Kinematics of Universal Joints.
3	Kinematics of Gears - Spur, Helical, Bevel, Worm.
4	Kinematics of Gear trains - Simple, Compound, Epicyclic, Differential and Worm Wheel Reducers.
<b>DYNAMICS - EXPERIMENTS</b>	
5	Turn table apparatus - Determination of M.I.
6	Motorized Gryoscope - Verification of Laws.
7	Connecting Rod and Flywheel - Determination of M.I. by oscillation.
8	Transmission Systems
9	Gear reducers - Determination of Transmission efficiency.
10	Governors - Watts, Porter, Proell and Hartnell - Determination of Sensitivity, effort etc.

**B.E. AUTOMOBILE ENGINEERING CURRICULUM****SEMESTER-6**

<b>Code no.</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>M</b>	<b>C</b>
<b>THEORY</b>						
	FINITE ELEMENT ANALYSIS (Common to Mechanical and Automobile Engineering)	3	2	0	100	4
	DESIGN OF CHASSIS AND CHASSIS SYSTEMS	3	1	0	100	4
	IC ENGINE DESIGN	3	1	0	100	4
	VEHICLE DYNAMICS	3	1	0	100	4
	TRANSPORT MANAGEMENT	3	0	0	100	3
	ENGINEERING ECONOMICS & FINANCE (Common to Mechanical and Automobile Engineering)	3	0	0	100	3
<b>PRACTICALS</b>						
	VEHICLE PERFORMANCE CHARACTERISTICS LAB	2	2	0	100	3
	SIMULATION & ANALYSIS LABORATORY	0	0	3	100	1.5
	VEHICLE MAINTENANCE LABORATORY AND MINI PROJECT	0		3	100	1.5
		0	0	4	100	2

## SEMESTER - VI

	<b>FINITE ELEMENT ANALYSIS</b> (Common to Mechanical and Automobile Engineering)	<b>3</b>	<b>1</b>	<b>0</b>	<b>100</b>	
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>8</b>
Historical background – Relevance of FEA to design problems, Application to the continuum – Discretisation – Matrix approach, Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Ritz method, Galerkin method						
<b>UNIT II</b>	<b>ONE DIMENSIONAL PROBLEMS</b>					<b>12</b>
Finite element modeling – Coordinates and shape functions – Potential energy approach– Element matrices and vectors – Assembly for global equations – Boundary conditions – Higher order elements - Shapes functions – Applications to axial loadings of rods – Extension to plane trusses – Bending of beams – Finite element formulation of stiffness matrix and load vectors – Assembly to Global equations –boundary conditions – Solutions and Post processing - Example Problems.						
<b>UNIT III</b>	<b>TWO DIMENSIONAL PROBLEMS – SCALAR VARIABLE PROBLEMS</b>					<b>6</b>
Finite element modeling – CST element – Element equations, Load vectors and boundary conditions – Assembly – Application to heat transfer - Examples						
<b>UNIT IV</b>	<b>TWO DIMENSIONAL PROBLEMS – VECTOR VARIABLE PROBLEMS</b>					<b>10</b>
Vector Variable problems – Elasticity equations – Plane Stress, Plane Strain and Axisymmetric problems – Formulation – element matrices – Assembly – boundary conditions and solutions Examples						
<b>UNIT V</b>	<b>ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL PROBLEMS</b>					<b>9</b>
Natural coordinates, Iso parametric elements, Four node quadrilateral element– Shape functions – Element stiffness matrix and force vector – Numerical integration - Stiffness integration – Displacement and Stress calculations – Examples.						
<b>LECTURE</b>					<b>:</b>	<b>45</b>
<b>TUTORIAL</b>					<b>:</b>	<b>15</b>
<b>TOTAL</b>					<b>:</b>	<b>60</b>
<b>TEXT BOOKS</b>						
1	Chandrupatla T.R., and Belegundu A.D., “Introduction to Finite Elements in Engineering”, Pearson Education 2002, 3 <sup>rd</sup> Edition.					
2	Logan D.L., “A First course in the Finite Element Method”, Third Edition, Thomson Learning, 2002					
<b>REFERENCE BOOKS</b>						
1	Rao S.S., “The Finite Element Method in Engineering”, Pergammon Press, 1989.					

2	David V Hutton "Fundamentals of Finite Element Analysis"2004. McGraw-Hill Int. Ed.
3	Robert D.Cook., David.S, Malkucs Michael E Plesha, "Concepts and Applications of Finite Element Analysis" 4 Ed. Wiley, 2003.
4	Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill International Student Edition, 1985
5	O.C.Zienkiewicz and R.L.Taylor, "The Finite Element Methods, Vol.1", "The basic formulation and linear problems, Vol.1", Butterworth Heineman, 5 <sup>th</sup> Edition, 2000

	<b>DESIGN OF CHASSIS AND CHASSIS SYSTEMS</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>100</b>	
<b>UNIT I</b>	<b>INTRODUCTION TO CHASSIS FRAME AND SUB-SYSTEMS</b>					<b>10</b>
<p>Types of vehicles – Classification of vehicles – conventional and off-highway vehicles – Multi axle vehicles - vehicle specifications - Different layouts of power plant with reference to location and drive - Types of frames – Frameless chassis - various forces acting on frames, different sections-materials.</p> <p>Calculation of power required to propel a vehicle.</p>						
<b>UNIT II</b>	<b>DESIGN OF STEERING AND SUSPENSION SYSTEM</b>					<b>13</b>
<p>Functions and requirements of steering system - conditions for true rolling of wheels – roll centre and roll axis - Steering linkages - steering kinematics - under steering and over steering –Calculation of steering wheel effort and pitman arm torque-design of pitman arm for equivalent stresses.</p> <p>Need of suspension system - factors affecting ride quality - Types of suspension systems–need anti-roll bar – Design of leaf and torsion bar spring –Basics of pneumatic suspension and design- Basics of shock absorber design-empirical relationships</p>						
<b>UNIT III</b>	<b>DESIGN OF PARALLEL AXIS GEARS AND GEAR BOXES</b>					<b>13</b>
<p>Gear tooth terminology - Speed ratio and number of teeth - Force analysis - Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width - power rating calculations based on strength and wear considerations. Design of spur gear.</p> <p>Parallel axis Helical Gears – Pressure angle in the normal and transverse plane - Equivalent number of teeth - forces and stresses - Design of helical gears.</p>						
<b>UNIT IV</b>	<b>DESIGN OF BEVEL AND WORM GEARS AND GEAR BOXES</b>					<b>11</b>
<p>Straight and spiral bevel gear tooth terminology - tooth forces and stresses - equivalent number of teeth - Design of straight tooth and spiral tooth bevel gears – Hypoid Gears.</p> <p>Worm Gear: Merits and demerits – terminology - Thermal capacity - materials - forces and stresses – efficiency – Design of single start and multi start worm gear pair.</p>						
<b>UNIT V</b>	<b>DESIGN OF BRAKES, WHEELS AND TYRES</b>					<b>13</b>
<p>Function, stopping time and distance, weight transfer during braking - Mechanical, hydraulic and pneumatic brake actuating mechanisms – design of brake shoes and friction pads. Design of drum and disc brakes .</p> <p>Types of wheels – spokes and rim types of wheels – alloy wheels – Wheel specification.</p> <p>Tire requirements, selection of tires, wheels and mountings – lateral force and friction coefficient, self aligning torque and caster offset, overturning moment, torque steer effects</p>						
					<b>LECTURE</b>	<b>: 45</b>
					<b>TUTORIAL</b>	<b>: 15</b>
					<b>TOTAL</b>	<b>: 60</b>

**TEXT BOOKS**

1	Reimpell J, Stoll. H, Betzler. J W, "The Automotive Chassis", SAE International, Second Edition, 2001.
2	Julian Happian-Smith, "An Introduction to Modern Vehicle Design", Butterworth Heinemann Publishers, 2002

**REFERENCE BOOKS**

1	Rudolf Limpert, "Brake Design and Safety", SAE International, Second Edition, 1999.
2	John Fenton, "Handbook of Automotive Power trains and Chassis Design", Professional Engineering Publishing, 1998
3	Donald Bastow, Geofry Howard and John P.Whitehead "Car Suspension and Handling", 4 <sup>th</sup> edition, SAE2004.
4	Giri N K, "Automobile Mechanics", Khanna Publishers, 2006.
5	Lukin R, Gasparyants G, Rodionov V, "Automobile Chassis Design and Calculations", MIR Publishers, Moscow, 1989.

<b>IC ENGINE DESIGN</b>		<b>3</b>	<b>1</b>	<b>0</b>	<b>100</b>
<b>UNIT I</b>	<b>INTRODUCTION</b>				<b>8</b>
Principles, design of engine based on vehicle characteristics, engine mounting and its types.					
<b>UNIT II</b>	<b>PISTON AND CONNECTING ROD</b>				<b>10</b>
Calculation of gas forces, variation of gas forces, design of piston, calculation of side thrust, piston pin, piston rings, materials. Design principles of connecting rod, procedure, selection of cross section, materials					
<b>UNIT III</b>	<b>CRANKSHAFT AND VALVE ACTUATING MECHANISM</b>				<b>10</b>
Determination of primary and secondary forces, balancing forces, calculation of rotating mass, location of mass, selection of materials. Design of valves, valve springs, tappet. Cam design, cam profile generation, cam shaft design, rocker and rocker shaft design considerations, materials					
<b>UNIT IV</b>	<b>DESIGN OF FLYWHEEL AND CLUTCH</b>				<b>10</b>
Need and role of a flywheel – Types of flywheels - Materials - Turning moment diagram - Determination of the mass of a flywheel for a given co-efficient of speed fluctuation - Stresses of rim flywheels - Design of hubs and arms of flywheel. Need and role and types of clutches – Design of single plate and multi plate clutches - Electronic engine systems Design: Electronic fuel system requirements and design					
<b>UNIT V</b>	<b>DESIGN OF COOLING AND LUBRICATION SYSTEM</b>				<b>7</b>
Principles of conductive, convective radiation heat transfer – basics of cooling system – Types of engine cooling systems and their places of usage - components design. Tribological characteristics of engine - fundamentals of lubrication system – Types of engine lubricating systems – Dry sump lubrication and applications - component design.					
				<b>LECTURE</b>	<b>: 45</b>
				<b>TUTORIAL</b>	<b>: 15</b>
				<b>TOTAL</b>	<b>: 60</b>
<b>TEXT BOOKS</b>					
1	Prabhu T J, “Design of Transmission Elements”, P R Lithographers, 2003.				
2	Lichty, “IC Engines”, Kogakusha Co., Limited , Tokyo, 1986.				
<b>REFERENCE BOOKS</b>					
1	Giles J G, “Engine Design”, Illiffee Books Ltd., London 1968				
2	John Fenton., “Gasoline Engine analysis for CAD’, MEP, London 1986.				
3	Fred Scarfer & Richard Van Basshuysen, “Internal Combustion Engine” Handbook-Basic Components, Systems and Perspectives”, SAE2004.				

4	Hall, Allen S Holowenko, Alfred R Laughlin, Herman G, "Schaum's Outline of Theory and Problems of Machine Design", Tata McGraw Hill Publishers, 2002
5	Heldt P M, "High Speed Combustion Engines", Oxford IBH Publishing Co., Calcutta, 1996.

<b>VEHICLE DYNAMICS</b>		<b>3</b>	<b>1</b>	<b>0</b>	<b>100</b>	
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>15</b>
Fundamentals of vibration, - Single, two, multi degrees of freedom systems - Derivation of equations of motion, influence coefficients, orthogonality principle, calculation of natural frequencies by Raleigh, Dunkerley, Holzer and matrix iteration methods, branched system, geared system. Modeling of an automobile for vibration study.						
<b>UNIT II</b>	<b>PERFORMANCE MODE:</b>					<b>13</b>
Acceleration - free body diagram of accelerating vehicle, maximum transferable tractive force, gradability, deceleration - maximum decelerating rates, stopping distance, maximum braking force, adhesion utilization - Straight line motion - aerodynamic forces and moments, viscosity effects -separation and its control - aerodynamic lift and its control - ground effect - profile for minimum drag.						
<b>UNIT III</b>	<b>RIDE MODE</b>					<b>10</b>
Effects of damping the vibration, vibration absorbers, pitch and bounce motion, oscillation centers - active and semi active suspension - Orthogonality of mode shapes, modal analysis, vehicle performance testing.						
<b>UNIT IV</b>	<b>HANDLING MODE</b>					<b>12</b>
Tyres - mechanics, testing and modeling, vehicle control - low speed cornering and static steering -Ackerman steering geometry, steady-state cornering - steering factors, vehicle control parameters (under steer, neutral steer and over steer), steady state handling - lateral acceleration gain, characteristic speed, yaw velocity gain and critical speed - effect of braking on vehicle handling - constant radius testing - fish hook measurement testing						
<b>UNIT V</b>	<b>VEHICLE STABILITY AND NOISE</b>					<b>10</b>
Load distribution. Calculation of Tractive effort and reactions for different drives - Stability of a vehicle on a slope, on a curve and a banked road. Properties of sound – sound level designation and measurements techniques - Sound isolation and absorption - machine enclosures, silencers and mufflers.						
					<b>LECTURE</b>	<b>: 45</b>
					<b>TUTORIAL</b>	<b>: 15</b>
					<b>TOTAL</b>	<b>: 60</b>
<b>TEXT BOOKS</b>						
1	Thomas D Gillespie, “Fundamentals of Vehicle dynamics”, SAE USA 1992					
2	Maurice Olley, “Chassis Design – Principles and Analysis”, Bentley publishers					
<b>REFERENCE BOOKS</b>						
1	Cole D E, “Elementary Vehicle Dynamics”, Ann Arbor, Michigan, USA, 1972.					
2	Wong J Y, “Theory of Ground Vehicles”, John Wiley & Sons, New York, 1978					

<b>TRANSPORT MANAGEMENT</b>		<b>3</b>	<b>1</b>	<b>0</b>	<b>100</b>	
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>12</b>
<p>Motor Vehicle Act: Short titles &amp; definitions, Laws governing to use of motor vehicle &amp; vehicle transport, Licensing of drivers &amp; conductors, Registration of vehicle, State &amp; interstate permits, Traffic rules, Signals &amp; controls, Accidents, Causes &amp; analysis, Liabilities &amp; preventive measures, Design of road complex, Responsibility of driver, Public &amp; public authorities, Offences, penalties &amp; procedures, Different types of forms. Government administration structure, Personnel, Authorities &amp; duties, Rules &amp; regulations, Rules regarding construction of motor vehicles</p>						
<b>UNIT II</b>	<b>INSURANCE</b>					<b>8</b>
<p>Insurance types &amp; significance, Comprehensive, Third party insurance, Furnishing of particulars of vehicles involved in accident, Award of the claims tribunal, MACT (Motor Accident Claims Tribunal), Solatium Fund, Hit &amp; Run case, Duty of driver in case of accident, Surveyor &amp; Loss Assessor, Surveyor's report</p>						
<b>UNIT III</b>	<b>PASSENGER TRANSPORT OPERATION</b>					<b>10</b>
<p>Structure of passenger transport organizations, Typical depot layouts, requirements, Problems on fleet management, Fleet maintenance, Planning - Scheduling operation &amp; control, personal &amp; training-training for drivers &amp; conductors, Public relations, Propaganda, publicity, passenger amenities, Advertisement work, Parcel traffic. Theory of fares, Basic principles of fare charging ,Differential rates for different types of services, Depreciation &amp; debt charges, operation cost, Revenues, Economics &amp; records.</p>						
<b>UNIT IV</b>	<b>GOODS TRANSPORT OPERATION</b>					<b>7</b>
<p>Structure of goods transport organizations, scheduling of goods transport, Management Information System (MIS) in passenger / goods transport operation, storage &amp; transportation of petroleum products</p>						
<b>UNIT V</b>	<b>TAXATION AND TRAFFIC MANAGEMENT</b>					<b>8</b>
<p>Objectives, Structure &amp; methods of laving taxation, One time tax, Tax Exemption &amp; tax renewal Traffic navigation, global positioning system</p>						
					<b>LECTURE</b>	<b>: 45</b>
					<b>TUTORIAL</b>	<b>: 0</b>
					<b>TOTAL</b>	<b>: 45</b>
<b>TEXT BOOKS</b>						
1	Motor Vehicle Act - Govt. of India Publications.					
2	Santosh Sharma, "Productivity in Road Transport", 2nd Edition, Association of State Road Transport Undertakings, New Delhi.					

<b>REFERENCE BOOKS</b>	
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1	P.G.Patankar, "Road Passenger Transport in India", CIRT, Pune.
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2	. Transport Development in India", S. Chand & Co. Pvt. Ltd., New Delhi.
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	<b>ENGINEERING ECONOMICS AND FINANCE ( Common to Mechanical and Automobile Engineering)</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>100</b>		
<b>UNIT I</b>	<b>INTRODUCTION TO ECONOMICS</b>					<b>8</b>	
Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Elements of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.							
<b>UNIT II</b>	<b>VALUE ENGINEERING</b>					<b>10</b>	
Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.							
<b>UNIT III</b>	<b>CASH FLOW</b>					<b>9</b>	
Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods							
<b>UNIT IV</b>	<b>REPLACEMENT AND MAINTENANCE ANALYSIS</b>					<b>9</b>	
Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.							
<b>UNIT V</b>	<b>DEPRECIATION</b>					<b>9</b>	
Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.							
					<b>LECTURE</b>	<b>:</b>	<b>45</b>
					<b>TUTORIAL</b>	<b>:</b>	<b>0</b>
					<b>TOTAL</b>	<b>:</b>	<b>45</b>

<b>Text Book</b>	
1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, NewDelhi, 2001	
<b>REFERENCES:</b>	
1.	Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002
2.	Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002
3.	Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 1984
4.	Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1976.
5	Smith, G.W., "Engineering Economy", Iowa State Press, Iowa, 1973.

## PRACTICAL

	<b>VEHICLE PERFORMANCE CHARACTERISTICS LAB</b>	0	0	3	100	
<b>LIST OF EXPERIMENTS</b>						
<ol style="list-style-type: none"> <li>1. Computation of engine torque and power curve using engine model equations</li> <li>2. Variation of tractive force with engine speed</li> <li>3. Calculation and plotting the curves of Air and Rolling resistances.</li> <li>4. Tractive force Vs speed calculation for manual transmission</li> <li>5. Acceleration and gradeability in different gears plotted for specifications</li> <li>6. Driving force against vehicle speed</li> <li>7. Braking deceleration with respect to applied braking forces</li> <li>8. Determination of under-steer and over-steer behavior for various vehicle dynamic Parameters</li> <li>9. Traction limited vehicle performance</li> <li>10. Roll centre and roll axis analysis for different suspension configuration.</li> </ol>						
<b>References:</b>						
<ol style="list-style-type: none"> <li>1. Lichty. " IC Engines ", Kogakusha Co.Ltd., Tokyo, 1991.</li> <li>2. Giri.N.K., " Automoblie Mechanics ", Khanna Publishers, New Delhi, 1986.</li> <li>3. Fundamentals of vehicle dynamics by Thomas Gillispie SAE bookstore 1992</li> </ol>						
Total No of periods					:	45

	<b>SIMULATION AND ANALYSIS LAB</b>	0	0	3	100	
<b>LIST OF EXPERIMENTS</b>						
<ol style="list-style-type: none"> <li>1. Study on automotive systems simulation</li> <li>2. Simulation and analysis of Rigid Axle Suspension system</li> <li>3. Simulation and analysis of Independent Suspension system</li> <li>4. Simulation and analysis of hydraulic brake system</li> <li>5. Simulation and analysis of air brake system</li> <li>6. Simulation of steady state cornering characteristics of vehicle</li> <li>7. Modeling of tires and analysis of cornering characteristics</li> <li>8. Roll stability and Rollover threshold analysis</li> <li>9. Simulation of a half car model for pitch and bounce</li> <li>10. Simulation of Quarter car model for sprung mass response for road inputs</li> </ol>						
<b>References:</b>						
<ol style="list-style-type: none"> <li>1. Cole, D., Elementary Vehicle Dynamics, course note in Mechanical Engineering, the University of Michigan, Ann Arbor MI, 1972.</li> <li>2. Wong, J.C., Theory of Ground Vehicle, John Wiley &amp; Sons, New York, 1978.</li> <li>3. Brake design and Safety .2<sup>nd</sup> edition Rudolf Limpert , SAE publications 1999</li> <li>4. Numerical Computing with Simulink: Creating Simulations Vol:1 Richard Gran SIAM, 2007</li> </ol>						
Total No of periods					:	45

	<b>VEHICLE MAINTENANCE LABORATORY</b>	0	0	3	100	
<b>LIST OF EXPERIMENTS</b>						
<ol style="list-style-type: none"> <li>1. Study and layout of an automobile repair, service and maintenance shop.</li> <li>2. Study and preparation of different statements / records required for the repair and maintenance works.</li> <li>3. Study and preparation of the list of different types of tools and instruments required.</li> <li>4. Minor and major tune up of gasoline and diesel engines.</li> <li>5. Fault diagnosis in electrical ignition system, gasoline fuel system, diesel fuel system and rectification.</li> <li>6. Study of the faults in the electrical systems such as Head lights, Side or Parking lights, , Electric horn system, Windscreen wiper system, Starter system and Charging system.</li> <li>7. Study of fuel filters (both gasoline and diesel engines) and air cleaners (dry and wet)</li> <li>8. Practice the following: <ol style="list-style-type: none"> <li>a. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel play</li> <li>b. Air bleeding from hydraulic brakes, air bleeding of diesel fuel system</li> <li>c. Wheel bearings tightening and adjustment</li> <li>d. Adjustment of head lights beam</li> <li>e. Removal and fitting of tyre and tube.</li> </ol> </li> </ol>						
<b>References:</b>						
<ol style="list-style-type: none"> <li>1. Service Manuals of reputed vehicles</li> <li>2. " Automotive Trouble shooting and Maintenance ", by Anderson Ashburn. McGraw-Hill Book Company (1990)</li> <li>3. A practical approach to Motor vehicle engineering and maintenance By Allan Bonnick &amp; Derek Newbold . Elsevier Publications 2005</li> </ol>						
Total No of periods					:	45