Dr. M.G.R
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY

DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech - AUTOMOTIVE ENGINEERING

CURRICULUM
(with effect from 2013)

TRIMESTER-I

S.No	Sub. Code	Title of Subject	L	T	P	C
1	MAE101	Applied Mathematics	3	1	0	4
2	MAE102	Structural Mechanics and Mechanisms	3	1	0	4
3	MAE103	Dynamics of Machines	3	1	0	4
4	MAE104	Fundamentals Concepts of Automobile Engineering.	3	0	0	3
5	MAE105	Tear Down Lab	0	0	2	1
		TOTAL	12	3	1	16

TRIMESTER-II

S.No	Sub. Code	Title of Subject	L	T	P	C
1	MAE 201	Automotive Transmission	3	0	0	3
2	MAE 202	Automotive Chassis and Suspension	3	0	0	3
3	MAE203	Engines and accessories	3	0	0	3
4	MAE 204	Vehicle Body Engineering	3	0	0	3
5	MAE 205	Seminars Based on Industrial Visits *	0	0	0	1
		TOTAL	12	0	0	13

*Students are supposed to undergo industrial trips to automotive industries and at the end of the trimester they will be required to give a seminar on the basis of the field trips.

TRIMESTER-III

S.No	Subject Code	Title of Subject	L	T	P	C
1	MAE 301	Vehicle Dynamics	3	0	0	3
2	MAE 302	Interiors & Ergonomics	3	0	0	3
3	MAE 303	Automotive Electrical and Electronics	3	0	0	3
4	MAE 304	Computer Aided Engineering.	3	0	0	3
5	MAE 305	Modeling lab	1	0	2	1
		TOTAL	13	0	2	13

TRIMESTER-IV

S.No	Subject Code	Title of Subject	L	T	P	C
1	MAE 401	Automotive Emission control	3	0	0	3
2	MAE 402	Crashworthiness and occupant safety.	3	0	0	3
3	MAE 403	Manufacturing of auto components	3	0	0	3
4	MAE 404	Simulation Lab	1	0	2	1
5	MAE 405	Mini project.	0	0	6	2
		TOTAL	10	0	8	12

TRIMESTER-V

S.No	Subject Code	Title of Subject	L	T	P	C
1	MAE 501	Internship (Main Project Work & Comprehensive VIVA)	0	0	20	12
		TOTAL	0	0	20	12

TRIMESTER-VI

S.No	Subject Code	Title of Subject	L	T	P	C
1	MAEE X	Elective – I	3	0	0	3
2	MAEE X	Elective – II	3	0	0	3
3	MAEE X	Elective – III	3	0	0	3
		TOTAL	09	0	0	09

TOTAL NO.OF CREDITS = 75

LIST OF ELECTIVES

Sl. No.		Title of Subject	L	T	P	C
1	MAEE 601	Two and Three wheelers	3	0	0	3
2	MAEE 602	Special type of vehicles	3	0	0	3
3	MAEE 603	Instrumentation and experimental techniques	3	0	0	3
4	MAEE 604	Finite element methods in automobile	3	0	0	3
5	MAEE 605	Vehicle control systems	3	0	0	3
6	MAEE 606	Combustion thermodynamics and heat transfer	3	0	0	3
7	MAEE 607	Simulation of IC engines	3	0	0	3
8	MAEE 608	Engine management system	3	0	0	3
9	MAEE 609	Automotive air conditioning system	3	0	0	3
10	MAEE 610	Alternative fuels and propulsion systems	3	0	0	3
11	MAEE 611	Vehicle maintenance	3	0	0	3
12	MAEE 612	Simulation of vehicle systems	3	0	0	3
13	MAEE 613	Hydraulic and pneumatic systems	3	0	0	3
14	MAEE 614	Automotive aerodynamics	3	0	0	3
15	MAEE 615	Rubber technology for automobiles	3	0	0	3

TRIMESTER-I

MAE 101 APPLIED MATHEMATICS 3 1 0 4

OBJECTIVE:

To have an exposure on various topics such as Matrix Theory, Calculus of Variations, Differential equations, Interpolation and Integration and Linear Programming problems to understand their applications in engineering problems.

UNIT I MATRIX THEORY 12

Eigen values using QR transformations – generalized eigenvectors – canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.

UNIT II DIFFERENTIAL EQUATIONS – NONLINEAR ORDINARY DIFFERENTIAL & PARTIAL DIFFERENTIAL EQUATIONS 12

Introduction – Equations, with separable variables – Equations reducible to linear form – Bernoulli's equation – Riccati's equation – Special forms of Riccati's equation – Laplace transform methods for one dimensional wave equation – Displacement in a long string – Longitudinal vibration of an elastic bar.

UNIT III CALCULUS OF VARIATION 12

Introduction – Euler's equation – several dependent variables Lagrange's equations of Dynamics – Integrals involving derivatives higher than the first – Problems with constraints – Direct methods and eigen value problems.

UNIT IV INTERPOLATION AND INTEGRATION 12

Hermite's Interpolation – Cubic Spline Interpolation – Gaussian Qundraline – Cubature.

UNIT V LINEAR PROGRAMMING PROBLEM 12

Simplex algorithm – Two phase and Big M Techniques – Duality theory – Dual simplex method – Integer programming.

Total hrs: 60

TEXT BOOKS

1. Stephenson, G, Radmore, P.M., Advanced Mathematical Methods for Engineering and Science students, Cambridge University Press 1999.
2. Bronson, R., Matrix Operations, Schaum's outline series, McGraw Hill, New York, 1989.
3. Kreyszig,E., Advanced Engineering Mathematics, John Wiley, 8th Edition, 2004.

REFERENCES

1. Froberg, C.E. Numerical Mathematics, The Benjamin/Cummings Publishing Co., Inc., 1985.
2. Jain, M.K., Iyengar, S.R.K., and Jain, R.K., Numerical Methods for Scientific & Engineering computation, Wiley Eastern Ltd., 1987.
3. Gupta, A.S. Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
4. Sankara Rao, K., Introduction to Partial Differential Equations, Prentice Hall of India Pvt Ltd., New Delhi 1997.
5. Boyce & Di Prima, Elementary Differential Equations and Boundary value problems, with ODE Architect CD, 8th Edition, 2005.

MAE 102 STRUCTURAL MECHANICS AND MECHANISMS 3 1 0 4

OBJECTIVE:

To study about the basics of structures-Load -Stress and Load-Deflection, Stress-strain relations, Failure theories of Stress and Strain, Basics of kinematics--Mobility –degrees of freedom-kinematic inversion-rotation and translation.

UNIT I BENDING 12

Definition of shear center in bending, Symmetrical and non-symmetrical bending, Bending stresses in beams subjected to non-symmetrical bending, Deflections of straight beams subjected to non-symmetrical bending, Effect of Inclined loads

UNIT II TORSION 12

Torsion of Prismatic bar of circular cross section, Saint-Venant's semi inverse method, Linear elastic solution, Narrow rectangular cross section, Hollow thin-wall torsion members, Multiply connected cross section, Thin wall torsion members with restrained ends, Numerical solution of torsion problems.

UNIT III VELOCITY AND ACCELERATON 12

Mechanisms: Slider crank Velocity and acceleration of simple and complex mechanisms using graphical method-four bar chain-single slider crank mechanism-double slider crank mechanism.

UNIT IV SYNTHESIS 12

Type, Number and. Dimensional synthesis - Function generation, path generation, body guidance. Two position synthesis of crank and rocker mechanism. Crank and rocker mechanism with optimum transmission angle. Three position synthesis, Four position synthesis, point precision reduction, precision position, structural error, chebychev spacing.

UNIT V SYNTHESIS OF LINKAGES 12

Coupler curve synthesis, cognate linkages, Robert-Chebychev theorem, Blocks method of synthesis, Freudenstein's equation, Analytical synthesis using complex algebra, Synthesis of dwell mechanisms.

Total hrs : 60

TEXTBOOK:

Arthur P.Boresh, "Advanced Mechanics of Materials, John wiley & sons.Inc.

REFERENCES :

1. Srinath L.N., "Advanced Mechanics of Solids, "Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Junarkar S.B., "Mechanics of Structures", Vol. 1, 21st Edition, Charotar Publishing House, Anand, India, 1995.
3. Sandor G.N. and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prentice Hall, 1984.
4. Shigley, J.E., and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw Hill, 1995.
5. Amitabha Ghosh and Ashok Kumar Mallik, "Theory of Mechanism and Machines", EWLP,Delhi, 1999.

MAE 103 DYNAMICS OF MACHINES 3 1 0 4

OBJECTIVE:

To study about the force analysis, balancing, vibrations, transverse and torsional vibration – governors .

UNIT I FORCE ANALYSIS 12

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.

UNIT II BALANCING 12

Static and dynamic balancing – Balancing of rotating masses in same plane and in different planes. Balancing of reciprocating masses-partial balancing of locomotives– tractive force, swaying couple and hammer blow.

UNIT III LONGITUDINAL VIBRATION 12

Basic features of vibratory systems –types of vibration – Degrees of freedom – free longitudinal vibration of Single degree of freedom – damping – logarithmic decrement –forced damped vibration-magnification factor-vibration isolation- transmissibility**.**

UNIT IV TRANSVERSE AND TORSIONAL VIBRATION. 12

Transverse vibration- single concentrated load, Uniformly loaded shaft , shaft carrying several loads and whirling of shafts-Torsional vibration-single, two and three rotor systems –Torsionally Equivalent shaft-geared system.

UNIT V MECHANISM FOR CONTROL 12

Governors – Types – Centrifugal governors –Watt, Porter , Proell and Hartnel Governors – Equilibrium conditions, Isochronous , Sensitivity , Hunting, Stability, Effort and Power of Governor-Controlling Force Diagram– Effect of friction – Gyroscopic Stabilization – Gyroscopic effects in Automobiles, ships and airplanes .

Total hrs : 60

TEXTBOOK:

1. Rattan S.S.,"Theory of Machines ", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1994.
2. Khurmi R. S, "Theory of Machines ", Eurasia Publishers 1998.

REFERENCES :

1. Thomas Bevan, "Theory of Machines ", CBS Publishers and Distributors, 1984.
2. Shigley J.E and Uicker J.J., "Theory of Machines and Mechanisms ", McGraw Hill Inc., 1995.
3. Dr.V.P.Singh." Theory of Machines "Dhanpat Rai and Co Private Limited"

MAE 104 FUNDAMENTAL CONCEPTS OF AUTOMOBILE ENGINEERING 3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge in automotive engine. The detailed concept, construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students. At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

UNIT I ENGINE BASIC THEORY 9

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 9

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 9

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 CHAMBER 9

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 9

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.

Total hrs: 45

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
   W.H.Crouse and A.L.Anglin, 'Automotive Emission control', McGraw Hill Book Co, 1995.
3. G.S.Springer and A.J.Patterson, 'Engine emissions and pollutant formation', plenum press, Newyork, 1985.

MAE 105 TEAR DOWN LABORATORY 0 0 2 1

OBJECTIVE:

The main objective of this course is to impart knowledge in the assembling and dismantling and study of different types of an engine and its various systems like steering system, transmission system, electrical system, ignition system, injection system, Braking system. At the end of the course the student will be well versed in the assembling and dismantling of any vehicles.

LIST OF EXPERIMENTS

1 Assembling and dismantling of the following:

(i) SI- engine.

(ii) CI- engine

(iii) V-8 Ford engine

(iv) Single plate, Diaphragm Clutch.

(v) Gear box

(vi) Transfer case

(vii) Differential

(viii) Front axle, Rear axle

(ix) Brake system

(x) Steering system

(xi) Suspension system

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TRIMESTER II

MAE 201 AUTOMOTIVE TRANSMISSION 3 0 0 3

OBJECTIVE:

The main objective of this subject is to impart knowledge in automotive transmission. The detailed concept, construction and principle of operation of various types of mechanical transmission components, hydro dynamic devices, hydrostatic devices and automatic transmission system will be taught to the students. The design of clutch and gearbox will also be introduced to the students. At the end of the course the students will have command over automotive transmission concepts and application.

UNIT I

CLUTCH AND GEAR BOX 9

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 9

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 9

Ford – T model gear box. Wilson gear box- electric transmission – hydraulic control systems of automatic transmission.

UNIT IV

HYDROSTATIC DRIVE AND ELECTRIC DRIVE 9

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 control systems.

UNIT V

AUTOMATIC TRANSMISSION APPLICATIONS 9

Chevrolet "Turbo glide" transmission. Toyota's Automatic transmission with Electronic control system. Continuously Variable Transmission (CVT) – Types – Operations.

Total hrs: 45

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

MAE 202 AUTOMOTIVE CHASSIS AND SUSPENSIONS 3 0 0 3

OBJECTIVE:

- Study of the constructional details and Theory of important drive line,Stuctural,
- Steering, Braking and Suspension Systems of Automobiles.
- Problem- Solving in Steering Mechanism, Propeller shaft, Braking and Suspension Systems are to be done.

UNIT I INTRODUCTION 6

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

UNIT II FRONT AXLE STEERING SYSTEM 9

Front axle type, rigid axle and split 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 assisted steering-modern steering system.

UNIT III DRIVE LINE STUDY 10

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, on-slip type, Differential locks and differential housing.

UNIT IV BRAKING SYSTEM 10

Types of brakes, principles of shoe brakes. Constructional details-materials, braking torque developed by leading and trailing shoes. Disk brake, drum brake theory, constructional details, advantages,Brake actuating systems. Factors affecting brake performance, Exhaust brakes, power and assisted brakes. testing of brakes.

UNIT V SUSPENSION SYSTEMS 10

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.

Total hrs: 45

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", llliffe 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",lllife Books Ltd, 1975.
3. Kirpal Singh. "Automobile Engineering". Standard publishers, Distributors, Delhi, 1999.
4. G.B.S.Narang,"Automobile Engineering", Hanna Publishers, Twelfth reprint New Delhi, 2005.
5. R.P.sharma," Automobile Engineering", Dhanpat rai & Sons. New Delhi, 2000.

MAE 203 ENGINES AND ACCESSORIES 3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge in automotive engine. The detailed concept. Construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students. At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

UNIT I ENGINE BASIC THEORY 9

Engine types – operating cycles of 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 9

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 9

Air cooling and water cooling – thermo sympon 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 COMBUSTON CHAMBER 9

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

UNIT V NEW ENGINE TECHNOLOGY 9

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 –electric engine management.

Total hrs: 45

TEXTBOOK:

1. J.B.heywood, International combustion engines Fundamentals'.Mc Graw Hill Book Co, 1989.
2. V.Ganesan,'Internal combustion Engines', Tata Mc Graw 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.

MAE 204 VEHICLE BODY ENGINEERING 3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge in the construction of vehicle, aerodynamic, concept, paneling of passenger car body trim. At the end of the course the student will be well versed in the design and construction of external body of the vehicles.

UNIT I CAR BODY DETAILS 9

Types of car bodies - visibility: regulation, driver's visibility, methods of improving visibility- safety: safety design, safety aspects. Constructional details of a passenger car.

UNIT II BUS BODY DETAILS 9

Classification of bus bodies – based on distance traveled, based on capacity of the bus and based on style & shape. Types of metal section used in the construction. Construction of Conventional and integral type bus.

UNIT III CAR AERODYNAMICS 9

Objects — Vehicle types of drag. Various types of forces and moments. Effects of forces and moments. Various body optimization techniques for minimum drag. Principle of wind tunnel technology. Flow visualization techniques. Test with scale models.

UNIT IV COMMERCIAL VEHICLE DETAILS 9

Classification of commercial vehicle bodies. Construction of Tanker body and Tipper body. Dimensions of drivers seat in relation to controls. Driver's cab design. Compactness of Driver's cab. Segmental construction of driver's cab.

UNIT V COMMERCIAL VEHICLE AERODYNAMICS 9

Effects of rounding sharp front body edges. Effects of different cab to trailer body Fore body pressure distribution. Effects of a cab to trailer body roof height. Commercial vehicle drag reducing devices. Modern painting process of a passenger car body.

Total hrs: 45

TEXTBOOK:

1. Powloski, J., 'Vehicle Body Engineering', Business Books Ltd, 1970
2. J.G. Giles, 'Body Construction and Design', Butterworth and Co., 1975

REFERENCES:

1. John Fenton 'Vehicle Body layout and analysis', Mechanical Engineering Pub. Ltd., 1984
2. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002

TRIMESTER III

MAE 301 VEHICLE DYNAMICS 3 0 0 3

OBJECTIVE: When the vehicle is at dynamic condition more vibration will be produced. It is essential to study about vibrations and how to reduce the vibration under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle. In this subject these aspects have been given.

UNIT I BASIC OF VIBRATION 9

Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies. Single degree of freedom, free, forced and damped vibrations. Magnification factor and transmissibility. Vibration absorber. Vibration measuring instruments. Two degree of freedom system. modal analysis.

UNIT II TYRES 9

Tire forces and moments, rolling resistance of tires, relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, ride properties of tyre.

UNIT III PERFORMANCE CHARACTERISTICS OF VEHICLE 9

Equation of motion and maximum tractive effort. Aerodynamics forces and moments. Power plant and transmission characteristics. Prediction of vehicle performance. Braking performance.

UNIT IV HANDLING CHARACTERISTICS OF VEHICLES 9

Steering geometry. Steady state handling characteristics. Steady state response to steering input. Transient response characteristics. Directional stability of vehicle.

UNIT V DYNAMICS OF SUSPENSION SYSTEM 9

Requirements of suspension system. Spring mass frequency, wheel hop, Wheel wobble, wheel shimmy, choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft, Hydraulic dampers and choice of damping characteristics. Compensated suspension systems. Human response to vibration, vehicle ride model. Load distribution. Stability on a curved track, banked road and on a slope.

Total hrs: 45

TEXTBOOK:

1. Rao J.S and Gupta. K "Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd., 2002.
2. J.Y.Wong,' Theory of ground vehicle', John Wiley and Sons Inc., Newyork, 1978
3. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005

REFERENCES:

1. Groover, "Mechanical Vibration", 7th Edition, Nem Chand &Bros, Roorkee, India, 2003.
2. W.Steeds, 'Mechanics of road vehicle' Illiffe Books Ltd, London 1992
3. JG.Giles, 'Steering, Suspension tyres', Illife Books Lid London 1975
4. P.M.Heldt, 'Automotive chassis', Chilton Co ., Newyork, 1982
5. J. R. Ellis, 'Vehicle Dynamics', Business Books, London, 1969.

MAE 302 INTERIORS & ERGONOMICS 3 0 0 3

OBJECTIVE:

Design creates emotions and makes the client fall in love with the product. Ergonomy instead –if not respected- creates the "protest" and make the client hate the product. A good interaction between these two disciplines creates a "winning" product with guaranteed functionality. The aim of the course is making the designers know the basics of ergonomics, specifying its impact on design in order to help designers think about the problem and select the best solution.

UNIT –I ERGONOMICS 9

Definition of ergonomics: history and evolution of ergonomics over the course of the last century; definition and fields of application; user centered design approach; ergonomics in the automobile: 6 main themes (habitation, accessibility, visibility, usability, appreciation, comfort on board).Driving as a complex task: driving as a primary task (driving) and secondary tasks (listening to music, adjusting the seats, looking at maps and other automatic actions); man-car-environment system; well-being on board: usability, comfort, appreciation; methods of well-being evaluation: SAE ranking.

UNIT –II ANTROPOMETRICS AND INTERFACES 9

Antropometrics: human measurements: total height, legs, bust, arms, hands, head, eyes; percentiles; human biomechanics (movements and strengths); human posture: driving posture (signs of habitation).Interfaces: car – man interaction; on board information systems; driving support systems; central Informatic system on board –interfaces and commands; training on design of the car interface system; understanding ergonomics and quality perception

UNIT-III DEVELOPMENT AND INSPECTION 9

Usability and evaluation techniques: interaction with design; trial testings
Development process: the concept; marketing requirements; ergonomics requirements; preparation of the package; presentation and choice of the final design;

UNIT-IV SENSES 9

Six main themes in ergonomics applied to the automotive field: - Inhabitance: general posture, the driver and the passengers, the seat movement, space- Accessibility: to the front seats, to the back seats, to the boot, -Visibility: front, rear, direct and indirect, towards the various objects, reflexes- Usability of commands: the steering wheel, the gear change, hand brake, diversion-driving lever, buttons, etc. - Satisfaction: the 5 human senses judging the various components- Comfort: vibration, muscular, interfacing, the seats

UNIT –V DESIGN OF ERGONOMICS 9

Ergonomics and design, a new perspective: interactive process with style department during the various stages of the making of the model. From Advanced Design to actual production. Case studies and practical examples (console and seats: mono frame, refined)

Reference: Transportation-Car Design., Advanced interior Design, Avetik Kalashyan

MAE 303 AUTOMOTIVE ELECTRICALS AND ELECTRONICS 3 0 0 3

OBJECTIVE:

To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems like Batteries, Starting System, charging System, Ignition System, Lighting System and Dash – Board Instruments, Electronic ignition system, various sensors and the role of ECU.

UNIT I BATTERIES AND STARTING SYSTEM 9

Different types of Batteries – Principle, Construction and Electrochemical action of Lead – Acid battery, Electrolyte, Efficiency, Rating, Charging, Testing and Maintenance. Starting System, Starter Motors – Characteristics, Capacity requirements. Drive Mechanisms. Starter Switches.

UNIT II CHARGING SYSTEM, LIGHTING SYSTEM AND ACCESSORIES 9

D.C. Generators and Alternators their Characteristics. Control cutout, Electrical, Electro-mechanical and electronic regulators. Regulations for charging. Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Lighting design, Dash board instruments, Horns, wiper, Trafficators, Warning system and safety devices.

UNIT III ELECTRONIC IGNITION AND INJECTION SYSTEMS 9

Spark plugs, Advance mechanisms. Different types of electronic ignition systems - variable ignition timing, distributor less ignition. Spark timing control. Electronic fuel injection systems. Engine mapping.

UNIT IV SENSORS IN AUTOMOBILES 9

Basic sensor arrangement. Types of sensors – Oxygen sensor, fuel metering/Vehicle speed sensor, mass air flow sensor, temperature sensor, altitude sensor, pressure sensor and detonation sensor. Various actuators and its application in automobiles.

UNIT V MICROPROCESSOR IN AUTOMOBILES 9

Microprocessor And Microcomputer controlled devices in automobiles such as instrument cluster, Voice warning system, Travel information system, Keyless entry system, Automatic Transmission. Environmental requirements (vibration, Temperature and EMI).

Total hrs: 45

TEXTBOOK:

1. Judge. A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 1992.
2. William B. Ribbens -Understanding Automotive Electronics, 5th edition- Butter worth Heinemann, 1998
3. Young. A.P., & Griffiths. L., Automobile Electrical Equipment, English Language Book Society & New Press, 1990.

REFERENCES:

1. Vinal. G.W., Storage Batteries, John Wiley & Sons inc., New York, 1985.
2. Crouse.W.H., Automobile Electrical Equipment, McGraw Hill Book Co Inc., New York, 1980.
3. Spreadbury.F.G., Electrical Ignition Equipment, Constable & Co Ltd., London, 1962.
4. Robert N Brady Automotive Computers and Digital Instrumentation, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.
5. Kohli P L., "Automotive Electrical Equipment", Tata McGraw Hill Publishing Co., Delhi, 2004

MAE 304 COMPUTER AIDED ENGINEERING 3 0 0 3

OBJECTIVE:

To study the various solid modeling features, Analyse the one and two and three dimensional models .

UNIT I : SOLID MODELING 9

Geometry & Topology, Solid representation, Techniques of volume modeling, Feature based modeling : Feature representation, Parametrics, Relations, Constraints, Feature Manipulation. Mass properties calculations, Assembly modeling & Assembly analysis. Product Data Exchange.

UNIT II: ONE DIMENSIONAL FINITE ELEMENT ANALYSIS 9

Linear bar element, Quadratic bar element, beam element, frame element. Development of Finite Element Models of discrete systems like Linear elastic spring, Torsion of Circular Shaft, Fluid flow through pipe, One dimensional conduction with convection.

UNIT III : TWO DIMENSIONAL FINITE ELEMENT ANALYSIS 9

Three noded triangular element, six noded triangular element, four noded quadrilateral element, eight noded quadrilateral element and nine noded quadrilateral element. Development of Finite Element Models for plane stress, plain strain, Axy-symmetric stress analysis applications.

UNIT IV: DYNAMIC ANALYSIS USING FINITE ELEMENTS 9

Vibration problems, Equations of motion based on weak form., Equations of motion using Lagrange's approach, consistent and lumped mass matrices, Solution of Eigen value problems, Transient vibration analysis. *Computational Flow Simulation***:** Meshing for flow simulation, finite volume methods, pressure-velocity coupling, and numerical stability.

UNIT V: THREE DIMENSIONAL FINITE ELEMENT ANALYSIS 9

Four node tetrahedral element, six node prism element, eight node hexahedral element and higher order elements. Boundary conditions, Mesh Generation, Mesh Refinement & other practical considerations.

REFERENCES:

1. Ibrahim Zeid, 'Mastering CAD/CAM', Tata McGraw Hill Co. Ltd. 2007
2. D F Roger, J Adams, 'Mathematical Elements for Computer Graphics', McGraw Hill Co. Ltd. New York
3. Larry Segerlind, 'Applied Finite Element Analysis', John Wiley & Sons, New York
4. J N Reddy, 'Introduction to Finite Element Method' , Tata McGraw Hill Co. Ltd, 2005
5. T R Chandraupatla, A D Belegundu, 'Introduction to Finite Elements in Engineering', Pearson Education, 3rd Ed.
6. K H Huebner, D L Dewhirst, D E Smith, T G Byrom, 'The Finite Element Method for Engineers', John Wiley & Sons, New York
7. P. Sheshu, Textbook of Finite Element Analysis, Prentice Hall of India, 2004
8. T Sundararajan and K Muralidhar, 'Computational Fluid Flow and Heat Transfer',

MAE 305 MODELING LAB 0 0 2 1

1. Part modeling of simple automotive components by using CATIA/PRO- E package.
2. Assembly modeling of automotive components by using CATIA/PRO.E package.
3. Using Pro-E or any other standard solid modular getting a hardcopy of 4 different automotive 3D objects.
4. Clutch complete design of clutch component, components and assemblies drawing using drafting software.
5. Gear Box: Gear train calculation, Layout of gear box, calculation of bearing loads and selection of bearing. Complete assembly drawing using software.
6. Piston: Complete design of piston component, components and assemblies drawing using CATIA software.
7. Connecting Rod: Complete design of Connecting rod component, components and assemblies drawing using CATIA software.

TRIMESTER IV

MAE 401 AUTOMOTIVE EMISSION CONTROL 3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge in automotive emission control. The detailed concept of formation and control techniques of pollutants like UBHC, CO, NO_x, particulate matter and smoke for both SI and CI engine will be taught to the students. The instruments for measurement of pollutants and emission standards will also be introduced to the students. At the end of the course the students will have command over automotive pollution and control.

UNIT I EMISSION FROM AUTOMOBILES 5

Various emissions from Automobiles — Formation — Effects of pollutants on environment human beings. Solution to pollution.

UNIT II EMISSIONS FROM SPARK IGNITION ENGINE AND ITS CONTROL 12

Emission formation in SI Engines- Carbon monoxide- Unburned hydrocarbon Nitric oxide. Lead particulate—Poly-nuclear Aromatic hydrocarbon emissions—Effects of design and operating variables on emission formation- controlling of pollutants from Engine- Thermal reacts — Catalytic converters — Charcoal Canister Control for evaporative emission — Positive Crank case ventilation system for UBHC emission reduction.

UNIT III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL 12

Physical and Chemical delay — Significance — Intermediate Compounds Formation — emission formation due to incomplete Combustion — Effect of Operating variables on Emission formation — White, Blue, and Black Smokes. Nitric Oxide and Particulate controlling of Emission — Operating Behavior- Fumigation EGR- Air Injection — Cetane number Effect.

UNIT – IV NOISE POLLUTION FROM AUTOMOBILES 8

Causes for Noise from Automobiles—Traffic Noise—Engine Noise—Transmission Noise—vehicle structural Noise, Exhaust Noise, Noise reduction in Automobiles — Encapsulation technique for noise reduction — Silencer Design on Sound reduction in automobiles.

UNIT – V TEST PROCEDURES AND EMISSION MEASUREMENTS 8

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Seven mode and thirteen mode cycles for Emission Sampling — Sampling problems — Quantifying Emissions — Measurement of CO, CO_2 by NDIR. Hydrocarbon emission by FID- Chemiluminesecent detector for Measurement of NOR— Smoke meters — Dilution Tunnel Technique for particulate Measurement- Sound level meters.

Total hrs:45

TEXTBOOK:

1. G.P.Springer and D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.
2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.

REFERENCES

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company., Newyork 1993.
3. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
4. C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.
5. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise', Applied science publisher ltd., London,1987

MAE 402 CRASHWORTHINESS AND OCCUPANT SAFETY 3 0 0 3

OBJECTIVE S:

To study about the automotive safety and occupant safety aspects including safety equipments.

UNIT I INTRODUCTION 9

Design of the body for safety, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

UNIT II SAFETY CONCEPTS 9

Active safety: driving safety, conditional safety, perceptibility safety, operating safety- passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, and speed and acceleration characteristics of passenger compartment on impact.

UNIT III SAFETY EQUIPMENTS 9

Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety, antiskid braking system, regenerative braking system, speed control devices.

UNIT IV COLLISION WARNING AND AVOIDANCE 9

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions, driver fitness detection.

UNIT V COMFORT AND CONVENIENCE SYSTEM 9

Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system, manual and automated wiper system, satellite control of vehicle operation for safe and fast travel.

Total hrs:45

TEXT BOOK:

1. Bosch, "Automotive Handbook", 6th edition, SAE, 2004.

REFERENCES:

1. J.Powloski - "Vehicle Body Engineering" - Business books limited, London - 1969.
2. Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999.
3 .ARAI Safety standards.

MAE 403 MANUFACTURING OF AUTO COMPONENTS 3 0 0 3

OBJECTIVE:

The objective of this course is to make the students to know and understand the production methods of various engine components like piston, connecting rod, crankshaft etc and various chassis components like friction lining materials, propeller shaft, steering column, gears etc.

UNIT I ELASTIC AND PLASTIC BEHAVIOUR OF MATERIALS 9

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 6

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 10

Forging materials - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, and 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 10

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 10

Powder injection moulding - 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.

Total hrs: 45

TEXT BOOK

1. Heldt.P.M., " High Speed Combustion Engines ", Oxford Publishing Co., New York, 1990.

REFERENCES

1. Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990.
2. Rusinoff, " Forging and Forming of metals ", D.B. Taraporevala Son & Co. Pvt Ltd., Mumbai, 1995.
3. Sabroff.A.M. & Others, "Forging Materials & Processes ", Reinhold Book Corporation, New York, 1988.
4. Upton, "Pressure Die Casting ", Pergamon Press, 1985.
5. High Velocity "Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990
6. HMT handbook.

MAE404 SIMULATION LAB 0 0 2 1

(FEA/CFD LAB)

1. Analysis of simple automotive components by using Ansys package.
2. Clutch: Complete design and analysis of clutch component using Ansys software.
3. Gear Box: Gear train calculation, Layout of gear box , calculation of bearing loads and selection of bearing. Complete Analysis using analysis software.
4. Piston: Complete design and Analysis of piston component, components and assemblies using Ansys software.
5. Connecting Rod: Complete design and Analysis of Connecting Rod component, using Ansys software.
6. SI Engine combustion Analysis by using Star CD.
7. CI Engine combustion Analysis by using Star CD
8. Inlet manifold injection CFD analysis using FLUENT
9. Exhaust manifold injection CFD analysis using FLUENT
10. Soot Model and analysis.

MAE405 **MINI PROJECT** **0 0 6 2**

Students should carry out innovative project in the area of automotives and submit a report at the end of Trimester. The project should be in the area of Design, analysis and fabrication of automotive components.

Viva – Voce examination with internal and external examiners will be conducted.

TRIMESTER V

MAE 501 **INTERNSHIP** **0 0 20 12**

Students should go for internship in a automotive industry for one full trimester. Students should take up a real time Project in the areas of Design / Analysis / Manufacturing of Automobile components and a report should be submitted at the end of Trimester. Viva – Voce examination with internal and external examiners will be conducted to evaluate the students.

ELECTIVES

FOR

TRIMESTER VI

MAE 601 TWO AND THREE WHEELERS 3 0 0 3

OBJECTIVE:

The objective of this course is to make the students to know and understand the constructional details, operating characteristics and design aspects of two and three wheelers.

UNIT I INTRODUCTION 7

Classifications- design considerations –weight and dimension limitations –requirements stability problems, gyroscopic effect- pendulum effect of two and three wheelers.

UNIT II POWER UNITS, IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS 12

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 III CLUTCHES AND TRANSMISSION 10

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. Freewheeling devices, starting systems.

UNIT IV FRAMES, SUSPENSION, WHEELS AND TYRES 8

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 V THREE WHEELERS 8

Auto rickshaws, different types, Pick-Ups and delivery type vehicle, frames and transmission for 3 wheelers wheel types, wheel attachment tyre types. Brakes and their operating mechanism.

Total hrs:45

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.

MAE 602 SPECIAL TYPE OF VEHICLES 3 0 0 3

OBJECTIVE:

The main objective of this course is to introduce the concept and principle of operation of special vehicles such as Bulldozers, Ditchers, Bucket excavators, farm equipments, military vehicles etc. At the end of the course, the students can have a better understanding of the application of the special types of vehicles in the excavation of earth.

UNIT I EARTH MOVING AND CONSTRUCTIONAL EQUIPMENTS 10

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 II POWER TRAIN CONCEPTS 7

Engine – converter match curves. Epicyclic type transmissions. Selection criteria for universal joints. Constructional details of steerable and drive axles of dumper.

UNIT III VEHICLE SYSTEMS, FEATURES 14

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler. Articulated vehicles, double decker. Firefighting equipment.

UNIT IV SPECIAL PURPOSE VEHICLES FOR INDUSTRIAL APPLICATIONS 5

Constructional features, capacity and stability of jib cranes. Vibratory compactors. Stackers, borewell machines, concrete mixtures.

UNIT V FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES 9

Ride and stability characteristics, power take off, special implementations. Special features and constructional details of tankers, gun carriers and transport vehicles. Harvesting vehicles.

Total hrs: 45

REFERENCES

1. Pipenger, ‘Industrial Hydralics’, Mcgraw Hill, Tokoyo, 1979.
2. A. Astakhov, ‘Truck cranes’, MIR Publishers, Moscow, 1971.
3. Bart H Vanderveen, ‘Tanks and Transport Vehicles’, Frederic Warne and co. Ltd., London, 1974.
4. K. Abrosimov, A. Bromberg and F. Katayer, ‘Road making machineries’, MIR Publisher, Moscow,1975.
5. SAE Handbook – Vol III, 1995.

MAE603 INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES 3 0 0 3

OBJECTIVE:

Study of the theory, construction and operation of different measurement technology, instruments transducers and their application in automotive industry.

UNIT I MEASUREMENT SYSTEMS 6

Static and Dynamic Measurement systems- Requirements and characteristics – Analysis of experimental detail, Error analysis.

UNIT II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES 8

Transducers for Automotive Applications – Amplifiers- filters –data Acquisition- Indicators, Printers and displays –Signal Analyzing.

UNIT III MECHANICAL MEASUREMENT 10

Instrumentation For Measuring Weight, Force, torque, pressure power, temperature, fluid flow, vibration, rotational speed, velocity, acceleration and angular motion.

UNIT IV ENGINE EXPERIMENTAL TECHNIQUES 12

I.S Code for Engine testing – Instrumentation for performance testing of engine, Instrumentation for Research and development, Instrumentation for noise, vibration, in cylinder gas flow, flame temperature Dynamic Cylinder pressure measurements.

UNIT V VEHICLE EXPERIMENTAL TECHNIQUES 9

Laboratory tests- test tracks - Endurance Tests- crash tests- wind tunnel tests- Brake tests.

Total hrs:45

TEXTBOOK:

1. J.G. Giles, 'Engine and Vehicle Testing', Illiffe books Ltd., London,1968.
2. T.G. Beckwith and Buck, 'Mechanical Measurements', Oxford and IBH Publishing House, New Delhi, 1995.

REFERENCES

1. A.W. Judge, 'Engineering Precision Measurement', Chapman and Hall Ltd, Essex Street W.C.,1951.
2. D.Patambis, 'Principle of Industrial Instrumentation', Tata McGraw Hill Publishing Co, New Delhi, 1990.
3. Rangan, Sharma and Mani, 'Instrumentation Devices and systems', Tata McGraw Hill Publishing Co., Ltd., 1990

MAE604 FINITE ELEMENT METHODS IN AUTOMOBILE 3 0 0 3

OBJECTIVE:

The objective of this course is to make the students to know and understand the principle of FEM and its application in automotive component design.

UNIT I INTRODUCTION 9

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

UNIT II 1D ELEMENTS 9

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 9

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 9

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 9

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.

Total hrs:45

TEXT BOOK:

1. Segerlind,L.J., Applied Finite Element Analysis, Second Edition, John Wiley and Sons Inc., New York, 1984
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. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 1987.
2. Ramamurthi,V., Computer Aided Design in Mechanical Engineering, Tata McGraw Hill, 1987.
3. Bathe,K.J. and Wilson,E.L., Numerical methods in finite element analysis, Prentice Hall of India Ltd., 1983.
4. J. N. Reddy, "Finite Element Methods", 2nd Edition, 6th Reprint, Tata McGraw Hill, 2005.
5. Singiresu S. Rao, "The Finite Elements Methods in Engineering", 4th Edition, USA, 2005.

MAE605 VEHICLE CONTROL SYSTEMS 3 0 0 3

OBJECTIVE:

To explain the principle of chassis management system and different sensors used in the systems.

UNIT I INTRODUCTION 9

Components of chassis management system – role of various sensors and actuators pertain to chassis system – construction – working principle.

UNIT II DRIVELINE CONTROL SYSTEM 9

Speed control – cylinder cut - off technology, Gear shifting control – Traction / braking control, brake by wire – Adaptive cruise control, throttle by wire. Steering - power steering, collapsible and tiltable steering column – steer by wire.

UNIT III SAFETY AND SECURITY SYSTEM 9

Airbags, seat belt tightening system, collision warning systems, child Lock, anti lock braking systems, Vision enhancement, road recognition system, Anti theft technologies, smart card system, number plate coding, central locking system.

UNIT IV COMFORT SYSTEM 9

Active suspension systems, requirement and characteristics, different types, Vehicle Handling and Ride characteristics of road vehicle, pitch, yaw, bounce control, power windows, thermal management system, adaptive noise control.

UNIT V INTELLIGENT TRANSPORTATION SYSTEM 9

Traffic routing system - Automated highway systems - Lane warning system – Driver Information System, driver assistance systems - Data communication within the car, Driver conditioning warning - Route Guidance and Navigation Systems – vision enhancement system - In-Vehicle Computing – Vehicle Diagnostics system – Hybrid / Electric and Future Cars – Case studies.

Total hrs: 45

TEXT BOOKS:

1. U. Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer-Verlag, 2000.
2. Ljubo Vlacic, Michel Parent, Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth-Heinemann publications, Oxford, 2001.

REFERENCES:

1. Crouse, W.H. & Anglin, D.L., "Automotive Mechanics", Intl. Student edition, 9th edition, TMH, New Delhi, 2002.
2. William B.Ribbens -Understanding Automotive Electronics, 5th edition, Butter worth Heinemann Woburn,1998.
3. Bosch, "Automotive HandBook", 6th edition, SAE, 2004.
4. Internet References

MAE606 COMBUSTION THERMODYNAMICS AND HEAT TRANSFER 3 0 0 3

OBJECTIVE: The objective of this course is to make the students to know and understand the principle of engine combustion and to introduce the various heat transfer models and its measuring methods.

UNIT I THERMODYNAMICS OF COMBUSTION 10

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.

UNIT II CHEMICAL KINETICS OF COMBUSTION 10

Fundamentals of combustion kinetics, rate of reaction, equation of Arrhenius, activation energy. Chemical thermodynamic model for Normal Combustion.

UNIT III FLAMES 12

Laminar premixed – flame speed correlations- quenching, flammability, and ignition, flame stabilization, laminar diffusion flames, turbulent premixed flames-Damkohler number.

UNIT IV HEAT TRANSFER IN IC ENGINES 8

Heat transfer and Engine Balance, measurement of Instantaneous heat transfer rate, heat transfer modeling, radiative heat transfer.

UNIT V EXPERIMENTS IN IC ENGINES 5

Rate of heat release – hot wire and laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines.

Total hrs:45

REFERENCES

1. Spalding.D.B., "Some fundamental of Combustion", Butterworth Science Publications, London, 1985.
2. 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.
3. Taylor.E.F. “The Internal Combustion Engines ", International Text Book Co., Pennsylvania, 1982.
4. V.Ganesan, ‘Internal combustion Engines’, Tata McGraw Hill Book Co, Eighth Reprint, 2005.
5. Ashley Campbel, “Thermodynamic analysis of combustion engine”, John book company, Newyork, 1979.
6. J.l.Ramos, “Modeling of Internal Combustion Engine”, McGraw hill book company New York 1990
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, 1996.

MAE607 SIMULATION OF IC ENGINES 3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge in computer simulation of IC engine process. The detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation of SI engine will be taught to the students. The simulation of two stroke SI engine will also be introduced to the students. At the end of the course the students will have command over simulation of IC engine process.

UNIT I INTRODUCTION 5

Simulation, advantages of computer simulation, step – by – step approach, reactive processes, heat reaction, measurement of URP, measurement of HRP.

UNIT II COMBUSTION STOICHIOMETRY 8

Introduction - combustion equation for hydrocarbon fuels – minimum air required for combustion – excess air supplied, conversion of volumetric analysis to mass analysis.

UNIT III ADIABATIC FLAME TEMPERATURE 10

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.

UNIT IV SI ENGINE SIMULATION WITH ADIABATIC COMBUSTION 10

Introduction, Engine details, temperature drop due to fuel vaporization, full throttle operation, work output and efficiency calculation, part-throttle operation, engine performance at part throttle, super charged operation, SI Engines simulation with progressive combustion.

UNIT V SI ENGINE SIMULATION WITH GAS EXCHANGE PROCESS 12

Introduction, gas exchange process, Heat transfer process, friction calculation, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram, brake power, brake thermal efficiency, effect of speed on performance, simulation of two stroke SI Engine.

Total hrs:45

TEXTBOOK:

1. Benson.R.S., Whitehouse.N.D., "Internal Combustion Engines", Pergamon Press, oxford, 1979
2. Ganesan.V. "Computer Simulation of spark ignition engine process", Universities Press (I) Ltd, Hyderbad, 1996.

REFERENCES

1. Ramoss.A.L., "Modelling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992.
2. Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley & Sons, New York, 1986.

MAE608 ENGINE MANAGEMENT SYSTEM 3 0 0 3

OBJECTIVE:

To explain the principle of engines electronic management system and different sensors used in the systems.

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines.

UNIT II SENSORS AND ACTUATORS 9

Inductive, Hall Effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, c Engine and vehicle design data rash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors.

UNIT III SI ENGINE MANAGEMENT 9

Three way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch Monojetronic, L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Working of the fuel system components. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contactless electronic ignition system, Electronic spark timing control.

UNIT IV CI ENGINE MANAGEMENT 9

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve.

UNIT V DIGITAL ENGINE CONTROL SYSTEM 9

Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control – Integrated engine control system, Exhaust emission control engineering, Electromagnetic compatibility – EMI Suppression techniques – Electronic dash board instruments – Onboard diagnosis system.

Total hrs:45

TEXT BOOKS:

1. Understanding Automotive Electronics William B Ribbens, SAE 1998
2. Automobile Electronics by Eric Chowanietz SAE

REFERENCES:

1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
2. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004

MAE609 AUTOMOTIVE AIR CONDITIONING SYSTEM 3 0 0 3

OBJECTIVE:

At the end of the course, the students will be able to understand the components of the automotive air-conditioning and their functions and the latest developments in this field.

UNIT I FUNDAMENTALS OF AIR-CONDITIONING, COOLING AND HEATING SYSTEM 9

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 9

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 9

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 9

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 9

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.

Total hrs:45

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 paper No: 931121,900084, 850040,931137,870029 etc.
6) Vehicle service manuals.

MAE 610 ALTERNATIVE FUELS AND PROPULSION SYSTEMS 3 0 0 3

OBJECTIVE :

To acquire knowledge of alternate fuels and the changes in the engine design for handling them and understand various propulsion systems for use in the automobiles.

UNIT I ALCOHOLS, NATURAL GAS, LPG, HYDROGEN 10

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.

UNIT II VEGETABLE OILS AND BIOGAS 7

Various vegetable oils for engines, esterification performance in engines, using biogas in engines, performance and emission characteristics.

UNIT III ELECTRIC AND HYBRID VEHICLES 11

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.

UNIT IV DRIVE LINE AND VEHICLE DESIGN FOR ELECTRIC VEHICLES 10

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 V HYBRID VEHICLE 7

Dual system operation, series and parallel hybrid different power series combinations for hybrids. Economy of hybrids.

Total hrs:45

TEXTBOOK:

1. Matheswar Dayal, “Energy today & tomorrow”, I &B Horishr India,1982.
2. Brad Ford Bates, Electric Vehicles, SAE, 1992.

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. SAE, Electric and Hybrid vehicles, PT21SAE, Warrendale, 1981.

MAE 611 VEHICLE MAINTENANCE 3 0 0 3

OBJECTIVE:

To have a complete knowledge of the vehicle maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail.

UNIT I MAINTENANCE TOOL, SHOP, SCHEDULE, RECORDS 8

Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

UNIT II POWER PLANT REPAIR AND OVERHAULING 12

Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system,- lubrication system. Power plant trouble shooting chart.

UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS 12

Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY 6

Body panel tools for repairing. Tinkering and painting. Use of soldering, metalloid paste.

UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS 7

Care, maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

Total hrs:45

TEXTBOOK:

1. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London , 1969.
2. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi, 1986.
3. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay, 1963

REFERENCES:

1. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.
2. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953.
3. John Dolce, Fleet maintenance, McGraw Hill, Newyork, 1984
4. A,W.Judge, Maintenance of high speed diesel engines, Chapman Hall Ltd., London, 1956.
5. V.L.Maleev, Diesel Engine operation and maintenance, McGraw Hill Book CO., Newyork, 1995.
6. Vehicle servicing manuals.
7. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay, 1963
8. S. Abbey, Automotive Transmission servicing and overhaul, Sir Issac Pitman, London, 1971.

MAE 612 SIMULATION OF VEHICLE SYSTEMS 3 0 0 3

OBJECTIVE:

To introduce the essential principles of simulation of various vehicle systems like longitudinal, lateral dynamics, modeling of suspension and tire system etc.

UNIT I LONGITUDINAL DYNAMICS AND CONTROL 9

Aerodynamic drag force - Longitudinal tire force - Rolling resistance - Calculation of normal tire forces - Calculation of effective tire radius - Driveline Dynamics - Torque converter - Transmission dynamics - Engine dynamics - Wheel dynamics - Cruise Control - Anti-Lock Brake Systems - Automated Highway Systems - Longitudinal Control Architecture.

UNIT II LATERAL DYNAMICS AND ELECTRONIC STABILITY CONTROL 9

Lateral Systems - Kinematic Model - Bicycle Model. Motion of Particle Relative to a rotating Frame. Dynamic Model in Terms of Error with Respect to Road, Yaw Rate and Slip Angle. Road Model. Differential Braking Systems - Steer-By-Wire Systems - Independent All Wheel Drive Torque Distribution

UNIT III MODELING OF PASSIVE AUTOMOTIVE SUSPENSIONS 9

Introduction - Modal Decoupling - Performance Variables - Natural Frequencies and Mode Shapes - Approximate Transfer Functions - Analysis of Vibrations in the Sprung Mass Mode and Unsprung Mass Mode - Verification Using Quarter Model. Half-Car and Full-Car Suspension Models.

UNIT IV MODELING OF SUSPENSION SYSTEM 9

Semi-Active Suspension Model - Optimal Semi-Active Control Law - Calculation of Transfer Function Plots - Performance of Semi-Active Suspension Systems. Active Automotive Suspensions - Trade-offs and Limitations - Invariant Points and Their Influence - Hydraulic Actuators for Active Suspensions

UNIT V LATERAL AND LONGITUDINAL TIRE FORCES 9

Tire Forces - Tire Structure - Longitudinal Tire Force at Small Slip Ratios - Lateral Tire Force at Small Slip Angles - Magic Formula Tire Model - Dugoff's Tire Model - Dynamic Tire Model - Development of Lateral Tire Model for Uniform Normal Force Distribution and Parabolic Normal Pressure Distribution - Combined Lateral and Longitudinal Tire Force Generation.

Total hrs:45

TEXTBOOK:

Rajesh Rajamani, "Vehicle Dynamics and Control", Springer, 2006.

MAE613 HYDRAULIC AND PNEUMATIC SYSTEMS 3 0 0 3

OBJECTIVE : The objective of this course is to introduce the essential principles of hydraulic and pneumatic system and related automobile applications.

UNIT I INTRODUCTION 6

Introduction to fluid power, properties - hydraulic fluids, air. Selection of hydraulic fluids, comparison between hydraulics and pneumatics. Symbols of pneumatic elements and hydraulic elements.

UNIT II PNEUMATIC SYSTEMS 12

Basic requirement of pneumatic system. Elements of pneumatics, constructional details of air compressors, air motors, control valves, actuators and mountings, filter, lubricator, regulator. General approach of system design, travel step diagram. Types - sequence control, cascade, step counter method. K.V.Mapping for minimization of logic equation. Simple circuits.

UNIT III HYDRAULIC SYSTEMS 12

Pumps and motors- types, characteristics. Cylinders, types, construction details. Valves for control of direction, flow and pressure, types, construction details. Power pack–elements, design. Pipes-material, pipe fittings. seals and packing. Maintenance of hydraulic systems. Selection criteria for cylinders, valves, pipes.

UNIT IV ADVANCED TOPICS IN HYDRAULICS AND PNEUMATICS 9

Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC-construction, types, operation, programming.

UNIT V AUTOMOTIVE APPLICATIONS 6

Hydraulic tipping mechanism, power steering, fort lift hydraulic gear, hydro-pneumatic suspension, air brake and maintenance and trouble shooting of pneumatic circuits.

Total hrs:45

TEXT BOOKS:

1. Anthony Espisito, " Fluid Power with Application", Pearson Education (Singapore) Pte.Ltd, Delhi, India, Fifth Edition, First Indian Reprint, 2003
2. Werner Deppert and Kurt Stoll, "Pneumatic Controls : An introduction to principles", Vogel-Druck Wurzburg, Germany, 1975
3. Pippenger, J.J, "Industrial Hydraulic & Pneumatics", McGraw Hill, 2002.

REFERENCES:

1. Majumdar, S.R., "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw- Hill Publishing Company Ltd., New Delhi, Fourth Reprint, 2003.
2. Peter Rohner, "Fluid Power Logic Circuit Design – Analysis, Design Method and Worked Examples", The Macmillan Press Ltd., UK, 1979.
3. Festo KG, "Pneumatic Tips", Festo, Germany, 1987.
4. Andrew Parr, "Hydraulic and Pneumatics", Jaico publishing house, 1999.

MAE614 AUTOMOTIVE AERODYNAMICS 3 0 0 3

OBJECTIVE: At the end of the course, the students will be able to apply basic principles of aerodynamics for the design of vehicle body.

UNIT – I INTRODUCTION 10

Scope – historical development trends – Fundamentals of fluid mechanics – Flow phenomenon related to vehicles – External & Internal flow problems – Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics.

UNIT – II AERODYNAMIC DRAG OF CABS 8

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.

UNIT – III SHAPE OPTIMIZATION OF CABS 7

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 – IV VEHICLE HANDLING 10

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 – V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 10

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.

Total hrs: 45

TEXTBOOK:

1. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 1997.

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.

MAE615 RUBBER TECHNOLOGY FOR AUTOMOBILES 3 0 0 3

OBJECTIVE : At the end, the student will have good exposure to role of various Rubber components in Automobiles.

UNIT I INTRODUCTION 6

Identification of plastics / rubber components in automobiles – function – selection criteria.

UNIT II STRUCTURE-PROPERTY RELATIONSHIP OF RUBBER 10

Resilience, creep, hysteresis and damping, stability, set and stress relaxation, behavior in dynamic applications.

UNIT III VIBRATION AND RUBBER SPRING 10

Principle of vibration isolation – rubber mounts – spring design – comparison with metallic springs – shape factor and its effect – forced and free vibrations with damping – typical mounts, compounding and manufacture.

UNIT IV FLUID SEALINGS AND FLEXIBLE COUPLINGS AND HOSES 10

Seals for static and dynamic applications – effect of heat / oil ageing – frictional behavior – fundamental of seal ability.

UNIT V COMPOUNDING AND MANUFACTURE 9

Types of couplings – specification and selection – torque Vs deflection relationships – brake fluid / hydraulic hoses, materials and manufacture.

Total hrs: 45

TEXTBOOK:

1. Freakley,P.K., and Payne,A.R., Theory and Practice of Engineering with Rubber, Applied Science Publishers Ltd.

REFERENCES:

1. Hobel,E.F., Rubber Springs Design.
2. Blow,C.M. and Hepburn,C., Rubber Technology and Manufacture.