NOORUL ISLAM CENTER FOR HIGHER EDUCATION

NOORUL ISLAM UNIVERSITY, KUMARCOIL

M.E. AUTOMOBILE ENGINEERING

CURRICULUM& SYLLABUS

SEMESTER I

THEORY						
Sl .No.	**Sub Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	MA1503	Applied Mathematics	3	1	0	4
2.	AM1501	Automotive Engines	3	0	0	3
3.	AM1502	Automotive Chassis	3	0	0	3
4.	AM1503	Automotive Transmissions	3	0	0	3
5.	AM1504	Autotronics	3	0	0	3
6.	EEXX1	Elective I	3	0	0	3
PRACTICAL						
7.	AM1571	Automotive Engine and Vehicle Components Laboratory	0	0	4	2
TOTAL			18	1	4	21

MA1503 APPLIED MATHEMATICS 3 1 0 4

AIM:

To equip the students in the field of variational problems, application to queuing system and numerical techniques which provide necessary mathematical support and confidence to tackle real life problems.

OBJECTIVE:

To impart the basic knowledge about Matrices, Transforms, Conformal Mappings and Numerical problems so that those concepts could be adopted in their concerned branch.

UNIT I ADVANCED MATRIX THEORY 9

Generalised Eigen vectors– Jordan canonical form — Matrix norms – Singular value decomposition – Pseudo inverse – Least square approximations – QR decomposition.

UNIT II CALCULUS OF VARIATIONS 9

Euler's equation – Functional dependent on first and higher order derivatives – Functional dependent on functions of several independent variables —Isoperimetric Problems.

UNIT III SIMULATION 9

Discrete Event Simulation – Stochastic Simulation - Monte Carlo Simulation – Generation of Random Numbers using Congruent method – Applications to Queueing systems.

UNIT IV CONFORMAL MAPPING 9

Schwarz – Christoffel Transformation – Transformation of boundaries in parametric form – Physical applications – Application to fluid flow and heat flow.

UNIT V FIRST AND SECOND ORDER ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9

Solution of first order differential equations -Single step Methods: Taylor's Series, Fourth order Runge-Kutta method. Finite difference solution of one dimensional heat equation: Bender Schmidt Method– One dimensional wave equation and two dimensional Poisson equations.

L: 45 + T: 15, TOTAL: 60 PERIODS

REFERENCES:

1. Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw–Hill, New York , 1989.
2. Spiegel, M.R.," Theory and Problems of complex variables with an introduction to conformal mapping and its applications. Schaum's outline series" McGraw-Hill Book Co,1964.
3. Gupta, A.S., "Calculus of Variations with Applications", Prentice-Hall of India, New Delhi, 1997.
4. Dr.Venkataraman, M.K., " Higher Mathematics for Engineering and Science", National Publishing Company, 1992.
5. Jain M.K., Iyengar. S.R.K and Jain. R.K, "Numerical method for scientific and Engineering Computations", New Age International(P) Ltd., Publishers, 2003.

6. Grewal B.S., “Higher Engineering Mathematics”- 40th Edition, Khanna Publishers, Delhi 2007.
7. Taha, H.A. “Operations Research: An Introduction”, Ninth Edition, Pearson Education Edition, Asia, New Delhi, 2002.
8. J.K Sharma “Operations Research” Macmillan, 2003

AM1501 AUTOMOTIVE ENGINES 3 0 0 3

AIM:

To impart the knowledge on basic concepts on Automotive Engines and its various sub componentsalong with its functions.

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, coolingand lubrication systems will be taught to the students. At the end of the course the students will havecommand over automotive engines and the recent development in the area of engines.

UNIT I ENGINE BASIC THEORY:

Engine types – otto, diesel, dual operating cycles - Engine design and operating parameters – Twoand four stroke engines - Typical performance curves for automobile engines- two stroke engine -performance and pollution aspects. **9**

UNIT II FUEL SUPPLY AND IGNITION SYSTEMS

Theory of carburetion and carburetors — Design aspects — Diesel fuel injection - pumps andinjectors, Introduction to Petrol Injection system - conventional ignition systems, advancemechanisms. **9**

UNIT III COOLING AND LUBRICATING SYSTEMS

Air cooling and water cooling – thermo syphon cooling, forced cooling systems. Fins and radiator -design aspects. Theory of lubrication — types of lubrication, splash lubrication system, petroillubrication system, forced feed lubrication system. **9**

UNIT IV AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS

Premixed combustion, diffused combustion, laminar and turbulent combustion of fuels in engines.Droplet combustion — combustion in SI and CI engines. Cylinder pressure data and heat release analysis. Optimized design of combustion chambers.Supercharger and Turbochargers. **9**

UNIT V NEW ENGINE TECHNOLOGY

Lean Burn engine – Different approaches to lean burn – LHR engine – Surface ignition concept –catalytic ignition – homogenous charge compression ignition – variable valve timing – Multi PortInjection System - Gasoline Direct Injection – Common Rail Direct Injection – Recent Trends. **9**

TOTAL: 45 PERIODS

TEXTBOOK

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

REFERENCES:

1. Edward F.Obert, 'Internal combustion engines and air pollution' Harber and Row Publishers, 1973.
2. M.Khovakh, 'Motor Vehicle Engines', Mir Publishers, Mascow,1976
3. W.H.Crouse and A.L.Anglin, 'Automotive Emission control', McGraw Hill Book Co, 1995.
4. G.S.Springer and A.J.Patterson, 'Engine emissions and pollutant formation', plenum press,Newyork, 1985.
5. M. L. Mathur, R. P. Sharma, "Internal combustion engines", DhanpatRai Publication, 2005
6. William Crouse, Donald Anglin, "AUTOMOTIVE MECHANICS", Tata McGraw Hill Book Co, 2006

AM1502 AUTOMOTIVE CHASSIS 3 0 0 3

OBJECTIVE

All automobiles have important driveline and structural components. This subject deals with the functions and constructional details of all the chassis components.

UNIT – I INTRODUCTION 9

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

UNIT – II FRONT AXLE AND STEERING SYSTEM 9

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

UNIT – III DRIVE LINE 9

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

UNIT – IV SUSPENSION SYSTEM 9

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

UNIT – V BRAKING SYSTEM 9

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

TOTAL: 45 PERIODS

TEXT BOOKS

1. Heldt.P.M.- "Automotive Chassis"- Chilton Co., New York- 1990
2. K.K.Ramalingam - "Automobile Engineering" – Scitech Publication, Chennai - 2001.

REFERENCES

1. Steed W - "Mechanics of Road Vehicles"- Illiffe Books Ltd., London- 1960
2. Newton Steeds and Garrot- "Motor Vehicles"- Butterworths, London- 2000.
3. Judge A.W- "Mechanism of the Car"- Chapman and Halls Ltd., London- 1986
4. Giles.J.G- "Steering, Suspension and tyres"- Iiiffe Book Co., London- 1988.
5. Crouse W.H- "Automotive Chassis and Body"- McGraw-Hill, New York- 1971.

AM1503 AUTOMOTIVE TRANSMISSIONS 3 0 0 3

OBJECTIVES

To impart basic knowledge to students with respect to transmission system of automobiles and impart knowledge that will enable the student to understand the latest developments in the field.

UNIT – I CLUTCHES AND GEAR BOX 9

Necessity of clutch in a automobile, different types of clutches, friction clutches, cone clutch, Single plate - multi coil & diaphragm spring clutches, multi plate clutch, centrifugal clutches, electromagnetic clutches, hydraulic clutches, torque capacity of clutches, clutch facing, materials, clutch adjustments, over running clutches, necessity and field of application, sprag and roller clutches, locking devices.

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.

UNIT – II DRIVE LINE 9

All spur and internal gear type planetary gearboxes, Ford T-model, Cotal and Wilson Gear box, determination of gear ratios, automatic overdrives., 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.

UNIT – III AXLE 9

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.

UNIT – IV FINAL DRIVE AND DIFFERENTIAL 9

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.

Hydrostatic drives: advantages and disadvantages, principles of hydrostatic drive systems, construction and working of typical hydrostatic drives, Janney Hydrostatic drive.

Electrical drives: advantages and limitations, principles of Ward Leonard system of control Modern electric drive for buses and performance characteristics.

UNIT – VAUTOMATIC TRANSMISSION 9

Need for fluid coupling and torque converters, Borg Warner type, control mechanisms, limitations. Transmission Electronics, Automatic Manual Transmission.

Relative merits and demerits when compared to conventional transmission, automatic control of gears, study of typical automatic transmissions, Ford and Chevrolet drive, automatic control of gear box.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Garrett T K, Newton K. and Steeds W. “Motor Vehicle”, Butter Worths& Co. Publishers Ltd., New Delhi, 2001.
2. Heinz Heisler, “Advanced Vehicle Technology”. Butterworth Heinemann Publishers, 2002.
3. Heldt P.M - Torque converters- Chilton Book Co.-1992
4. Newton and Steeds - Motor Vehicle- Illiffee Publisher- 2000

REFERENCES:

1. Crouse W H, "Automotive Chassis and Body," McG raw Hill Book Co., 5th edition, 1976.
2. Crouse W H, "Automotive Transmissions and Power Trains", McGraw Hill Book Co., 5th edition, 1976.
3. Fenton J, “Hand book of Automotive Power Trains and Chassis Design”, Progressive publisher, 1998.
4. Martin W Stockel and Martin T Stockel, “Auto Mechanics Fundamentals ", The Good Heart and Wilcox Co. Inc., 1982.
5. Axle suspension for rigid axles in vehicles - Patent 6129367.
6. US Patent No 5217418, Drivelines for wheeled vehicles.
7. Patent No. 6837821, Differential.
8. Design Practices, passenger Car Automotive Transmissions- SAE Hand book- 1994.

AM1504 AUTOTRONICS

3 0 0 3

UNIT I: AMPLIFIERS and FILTERS: 9

MOS and BJT inverting amplifier - Improving performance of inverting amplifier - CMOS and BJT differential amplifiers - Characterization of Op-Amp - The BJT two stage op-amp - The CMOS two stage op-amp - Op-amps with output stage, Folded Cascade op-amp, Trans-conductance Amplifier. Low pass filters - High pass filters – Band Pass filters – Phase Locked Loops.

UNIT II: SENSORS AND ACTUATORS: 9

Types of sensors, sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

UNIT III: ELECTRONIC CONTROL UNIT: 9

Microprocessors, microcontrollers, types of memory, memory interface, interrupts, input/output interfacing. Engine control module, power train control module, hardware and software components, interfacing with sensors, system integration.

UNIT IV: ENGINE ELECTRONICS: 9

Throttle body fuel injection, multi point fuel injection, gasoline direct injection, common rail direct injection, variable timing ignition, distributor less ignition. Engine mapping, on - board diagnostics.

UNIT V: TRANSMISSION ELECTRONICS: 9

Basic electronic controls-Multiplexing and De-multiplexing electronically controlled automatic transmission system. Electronics control transmission-Continuously variable transmission system-Hybrid transmission.

TOTAL: 45 PERIODS

REFERENCES:

1. Jose E. Franca Hannis Tsividis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing",Prentice Hall, International Edition, 2002.
2. David A. Johns, Ken Martin, “Analog Integrated Circuit Design” John Wiley & Sons, 2002.
3. Benhard Razavi, “Data Converters” Kluwer Publishers, 2000.
4. Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design" Oxford University Press, 2000.
5. Robert Bosch, “Automotive Hand Book” SAE, 5th edition, 2000.
6. Jacob Baker R., Lee H.W. and Boyce D.E., “CMOS Circuit Design, Layout and Simulation”’ Prentice Hall of India, 1998.

7. William B.Riddens -Understanding Automotive Electronics, 5th edition- Butter worth Heinemann Woburn- 1998.
8. Mohammed Ismail and Terri Faiz Analog VLSI Signal and Information Process, Mc-Graw Hill Book Company, 1994.
9. Randall L. Geiger, Phillip E. Allen, Noel R. Strader, "VLSI Design Techniques for Analog and Digital Circuits", M

AM1571AUTOMOTIVE ENGINE AND VEHICLE COMPONENTS LABORATORY

0 1 2 2

1. Dismantling of 4 cylinder petrol engine.
2. Assembling of 4 cylinder petrol engine.
3. Dismantling and Assembling of 4 cylinder Engine Head.
4. Dismantling, inspection and assembling of any one type steering gear box.
5. Dismantling, inspection and assembling of mechanical braking system
6. Dismantlingand assembling of Suspension system.
7. Dismantling, inspection and assembling of Clutch assembly.
8. Dismantling, inspection and assembling of Gear box.
9. Dismantling, inspection and assembling of Front Axle.
10. Dismantling, inspection and assembling of Rear Axle.
11. Dismantling, inspection and assembling Differential Unit.
12. Study of vehicle cooling and lubrication system.

TOTAL: 45

LIST OF EQUIPMENTS

(for a batch of 18 students)

1.	Four cylinder petrol engine	-1No.
2.	Cylinder Head 4 cylinder Engine	-2 No
3.	Front axle	- 1 No.
4.	Rear axle	- 1 No.
5	Steering gear box (Rack and pinion)	- 1 No. each
6	Mechanical brake system	- 1 No.
7	Leaf spring, coil spring, torsion bar	- 1 No. each
8	Clutch assembly	- 1 No.
9	Gear box (light duty, heavy duty)	- 1 No. each
10	Differential Unit	-1No.
11	Water pump, thermostat, radiator, temperature gauge	-1 No. each
12	Lub. oil pump, Pressure relief valve, filter, oil pressure gauge	-1 No. each

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SEMESTER II

THEORY						
Sl .No.	**Sub Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	AM1505	Combustion Thermodynamics And Heat Transfer	3	0	0	3
2.	AM1506	Vehicle Control Systems	3	0	0	3
3.	AM1507	Engine and vehicle components design	3	0	0	3
4.	AM1508	Vehicle Dynamics	3	0	0	3
5.	AM1509	Automotive Pollution and Control	3	0	0	3
6.	EEXX1	Elective I	3	0	0	3
PRACTICAL						
7.	AM1572	Modeling and Simulation of Auto Components Laboratory	0	0	4	2
TOTAL			18	0	4	20

AM1505 COMBUSTION THERMODYNAMICS AND HEAT TRANSFER

3 0 0 4

OBJECTIVE:

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

UNIT I THERMODYNAMICS OF COMBUSTION 9

Premixed and diffusion combustion process in IC engines. First and Second Law of Thermodynamics applied to combustion- combustion Stoichiometry- chemical equilibrium, spray formation and dropletcombustion.

UNIT II CHEMICAL KINETICS OF COMBUSTION 9

Combustion kinetics, rate of reaction, equation of Arrhenius, activation energy. Chemicalthermodynamic model for Normal Combustion.

UNIT III FLAMES: 9

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

UNIT IV HEAT TRANSFER IN IC ENGINES 9

Engine Heat transfer and heat Balance. Measurement of Instantaneous heat transfer rate. Heat transfer modeling. Heat transfer coefficients, radiative heat transfer. Temperature measurement inPiston, Cylinder, Cylinder Head, Liner and valves.

UNIT V INSTRUMENTATION: 9

Pressure sensors, crank angle encoder.Hot wire and laser Doppler anemometry and velocimetryforflow and combustion analysis in IC engines.In-cylinder pressure measurement and Rate of heatrelease calculation.

TOTAL: 45PERIODS

REFERENCES

1. Spalding.D.B., "Some fundamentals of Combustion", Butterworth Science Publications, London,1985.
2. Irvin Glasman, “Combustion” Academic Press, London, 1987, ISBN 0-12-285851-4.
3. Taylor.E.F. “The Internal Combustion Engines ", International Text Book Co., Pennsylvania, 1982.
4. Ashley Campbel, “Thermodynamic analysis of combustion engine”, John book company, Newyork,1979.
5. J.l.Ramos, “Modeling of Internal Combustion Engine”, Mcgraw hill book company New york 1990
6. John. B. Heywood,’ “Internal Combustion Engines", Tata McGraw Hill Co., Newyork, 1988.
7. Ganesan.V. "Computer Simulation of Spark Ignition Engine Process ", Wiley eastern India ltd,1996.

AM1506 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 pertaining tochassis system – construction – working principle of wheel speed sensor, steering position, tyrepressure, brake pressure, steering torque, fuel level, Engine and vehicle design data.

UNIT II DRIVELINE CONTROL SYSTEM: 9
Speed control – cylinder cut - off technology, Gear shifting control – Traction / braking control, brakeby wire – Adaptive cruise control, throttle by wire. Steering - power steering, collapsible and tiltablesteering column – steer by wire.

UNIT III:DRIVER ASSISTANCE SYSTEMS &TELEMATICS: 9

Introduction, driver support systems – driver information, driver perception, driver convenience, driver monitoring, Vehicle support systems – general vehicle control, collision avoidance, vehicle status monitoring, Global positioning systems, geographical information systems, navigation systems, automotive vision system,road recognition, driver assistance systems.

UNIT IV SAFETY, SECURITY&COMFORT SYSTEM: 9
Airbags, seat belt tightening system, collision warning systems, child Lock, anti lock braking systems,anti - spin regulation, traction control systems, Anti theft technologies, smart card system, numberplate coding, central locking system.Active suspension systems, requirement and characteristics, different types, power steering, collapsibleand tiltable steering column, power windows.

UNIT V INTELLIGENT TRANSPORTATION SYSTEM 9
Traffic routing system - Automated highway systems - Lane warning system – Driver InformationSystem, 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: 45 PERIODS

TEXT BOOKS:

1. U. Kiencke, and L. Nielsen,Automotive Control Systems,SAE and Springer-Verlag, 2000.
2. LjuboVlacic, 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, NewDelhi, 2002.
2. William B.Ribbens -Understanding Automotive Electronics, 5th e
3. Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.

AM1507 ENGINE AND VEHICLE COMPONENTS DESIGN 3 0 0 3

UNIT – I DESIGN OF ENGINE COMPONENTS 9

Calculation of gas forces, variation of gas forces, Choice of material for cylinder and piston, piston friction, piston slap, design of cylinder, piston, piston pin, piston rings, materials , piston failures, lubrication of piston assembly, Material for connecting rod, determining minimum length of connecting rod, small end and big end design, shank design, design of big end cap bolts, connecting rod failures, balancing of I.C. Engines, , material for crankshaft, design of crankshaft, balancing weight calculations.

UNIT – II DESIGN OF VALVES, FLYWHEEL, CLUTCHES AND GEARS 9

Design of valves, valve springs, tappet. Cam design, cam profile generation, cam shaft design, rocker and rocker shaft design considerations, materials Design aspects of intake and exhaust manifolds, inlet and Exhaust valves, valve springs, tappets, valve train. Materials and design of flywheel. Design of single and multi-plate clutches, materials. Design of spur, helical, straight, spiral bevel gears and herringbone gears, Gear box design.

UNIT III DESIGN OF FRAMES 9

Different layouts with reference to power plant, location and drive. Engineering materials and their physical properties applied to design, selection of materials, factor of safety,
Types of frames, various forces acting on frames, different sections, materials, crash safety, Operating condition on frames.

UNIT-IV DESIGN OF STEERING SYSTEM 9

Functions, requirements, conditions for true rolling – Ackerman and Davis mechanisms, roll centre and roll axis. Steering geometry – camber, castor, king pin inclination, toe-in, toe out, steering angle and steering ratio. Steering gear boxes- recirculating ball, worm and worm wheel, rack and pinion. Steering linkages, steering kinematics.

UNIT – V DESIGN OF SUSPENSION,BRAKING SYSTEM AND TYRES 9

Types of suspension, factors affecting ride quality, suspension springs. Shock absorbers, different suspension systems, suspension spring design,Function, stopping time and distance, weight transfer during braking, brake actuating mechanisms – mechanical, hydraulic and pneumatic, disc and drum brakes. Tyre requirements, selection of tyres, wheels and mountings – lateral force and friction co-efficient ,torque steer efect

TOTAL: 45 PERIODS

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.

REFERENCES:

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”, 4th 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.

AM1508 VEHICLE DYNAMICS 3 0 0 3

UNIT 1 **9**

Total resistance to a moving vehicle- air, rolling and grade resistance, power for propulsion, traction and tractive effort, Performance of cars and light trucks- Vehicle drag-deformation of the wheel, deformation of the ground, Road performance curves- acceleration, gradability and drawbar pull, acceleration time and elasticity, fuel consumption and fuel economy, strategy for lowest fuel consumption, factors affecting fuel economy, Corporate Average Fuel Economy (CAFÉ), driving schedules – EPA urban and highway cycles, European driving cycles.

UNIT – II **9**

Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, actors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity,

UNIT-III **9**

Vehicle handling: Steering angle, cornering force, low speed turning, high speed cornering, suspension effects on cornering, self righting torque, slip angle, over steer, under steer, steady state cornering, driving torques on steering, effect of camber, camber thrust, transient effects in cornering,

UNIT IV **9**

Stability of vehicles: Distribution of weight (Three wheeled and four wheeled vehicles), stability of a vehicle on a slope, Dynamics of vehicle running on a banked track, Stability of a vehicle taking a turn, Braking requirements, stopping distance, braking efficiency, work done in braking, tyreadhersion, braking of vehicles.

Road testing methods: Measurement of aerodynamic drag force in a coast – down test, cross wind tests, engine cooling road test, wind noise measurement on the road.

UNIT V **9**

Suspension: Vehicle dynamics and suspension requirements, choice of suspension spring rate, chassis springs and theory of chassis springs, Gas & hydraulic dampers, and choice of damper, damper Characteristics, Roll axis and the vehicle under the action of side forces.

Tyres: Tyre dimensions and specifications, Ride characteristics of tyres, wheel hop, wheel wobble, wheel wander, wheel shimmy, behavior while cornering, cornering force, powerconsumed by a tyre, effect of driving and braking torque, factors affecting tyre life, tread designs.

TOTAL: 45 PERIODS

REFERENCES:

1. W. Steeds- Mechanics of road vehicles- Wildlife book Ltd, London, 1990
2. Thomas D. Gillespie – Fundamentals of road vehicles - SAE, 1992
3. N.K. Giri- Automobile mechanics, Khanna Publishers, Delhi, 1986
4. Wolf- Heinrich Hucho – Aerodynamics of road vehicles, SAE
5. J.G. Giles- steering, suspension and tyres, Wildlife books Ltd, London, 1968
6. P.M. Heldt- Automotive chassis, Chilton Co., New York, 1952
7. TY. Wong- Theory of ground vehicles, Johnwiley and sons Inc, New York
8. Kripalsingh- Automobile Engineering-Vol-I, Standard Publishers, Delhi
9. R.P.Sharma- A course in Automobile Engineering, DhanpatRai publications

AM1509 AUTOMOTIVE POLLUTION AND CONTROL 3 0 0 3

OBJECTIVE:

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

UNIT I EMISSION FROM AUTOMOBILES 9

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of pollutants onenvironment and human beings. Emission control techniques – Modification of fuel, after treatmentdevices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyrerecycling

UNIT II EMISSION FROM SPARK IGNITION ENGINE AND ITS CONTROL 9

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide – Unburned hydrocarbon,NOx, Smoke —Effects of design and operating variables on emission formation – controlling ofpollutants - Catalytic converters, Charcoal Canister, CCS, Positive Crank case ventilation system,Secondary air injection, thermal reactor, Laser Assisted Combustion.

UNIT III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL 9

Formation of White, Blue, and Black Smokes, NOx, soot, sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of Operating variables on Emissionformation — Fumigation, Split injection, Catalytic Coating, EGR, HCCI, Particulate Traps, SCR, Fueladditives — Cetane number Effect.

UNIT IV NOISE POLLUTION FROM AUTOMOBILES 9

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aerodynamics noise,Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction —Silencer Design

UNIT V TEST PROCEDURES AND EMISSION MEASUREMENTS 9

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dyno -Seven mode and thirteen mode cycles for Emission Sampling — Sampling problems — Emissionanalysers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level
meters.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. G.P.Springer ad 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 ArborScience 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 sciencepublisher ltd., London,1987.

AM1572 MODELING AND SIMULATION OF AUTO COMPONENTS LABORATORY 0 0 4 2

Introduction to File Import, Export – DXF, IGES, STL, STEP 3 D Modeling and Simulation of Manufacture of the following parts :

1. Cylinder Head.
2. Cylinder.
3. Piston.
4. Piston Pin and Piston Rings.
5. Connecting Rod.
6. Crankshaft
7. Inlet and Exhaust Valves
8. Cam andCam Shaft.
9. Steering System
10. Brake System
11. Suspension System
12. Chassis Frame

LIST OF EQUIPMENTS

(for a batch of 30 students)

1.	Computer system	- 30 Nos.
2.	Software like Pro-E , Master CAM	- 15 licenses

TOTAL: 45 PERIODS

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M.E.AUTOMOBILE ENGINEERING

CURRICULUM & SYLLABUS

SEMESTER III

S.No.	Course Code	Course Title	L	T	P	C
THEORY						
1.	xxxE3	Elective III	3	0	0	3
2.	xxxE4	Elective IV	3	0	0	3
3.	xxxE5	Elective V	3	0	0	3
PRACTICAL						
4.	AM15P1	Industry Internship Training	0	0	4	2
5.	AM15P2	Project work – Phase I	0	0	18	6
TOTAL			9	0	22	17

AM15P1 INDUSTRIAL INTENSHIP TRAINING 0 0 4 2

The objective of the training in an industry for the students of M.E., Automobile Engineering is

- Know the real life problem of any industry
- Understand the importance of team work, cross culture, regulations and disciplines of industries.
- Prepare himself for meeting the requirements of industries

The scope of this training is to undergo intensive inplant training for at least 15 days in any of the process industries, study the processes and operations submit the report of the training with the information about the product, process and the identified problems, along with the certificate and present before the review committee

Outcome

- The students will have real life industrial problems for their project work
- The student will know the state of the art of the technology of industries
- The student will understand the environment and change/adopt this culture towards industrial practice.

Duration: 2- 3 weeks

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M.E. AUTOMOBILE ENGINEERING

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SEMESTER IV

Course Code	Course Title	L	T	P	C
AM15P5	Project Work – Phase II	0	0	36	18
TOTAL		0	0	36	18

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LIST OF ELECTIVES

ELECTIVES						
Sl.No	**SUB CODE**	**COURSE NAME**	**L**	**T**	**P**	**C**
1	AM15A1	IC Engine Process Modeling	3	0	0	3
2	AM15A2	Two and Three Wheelers	3	0	0	3
3	AM15A3	Theory of Fuels and Lubricants	3	0	0	3
4	AM15A4	Special Type of Vehicles	3	0	0	3
5	AM15A5	Instrumentation and Experimental Techniques	3	0	0	3
6	AM15A6	Engine Management System	3	0	0	3
7	AM15A7	Computational Fluid Dynamics	3	0	0	3
8	AM15A8	Design of Brakes, Steering andRunning Gears	3	0	0	3
9	AM15A9	Noise Vibration andHarshness Control	3	0	0	3
10	AM15B1	Automotive Component Manufacturing	3	0	0	3
11	AM15B2	Automotive Materials	3	0	0	3
12	AM15B3	Electric and Hybrid Vehicles	3	0	0	3
13	AM15B4	Automatic transmission	3	0	0	3
14	AM15B5	Finite Element Methods in Automobile Engineering	3	0	0	3

AM15A1 IC ENGINE PROCESS MODELING 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 SIengine will be taught to the students. The simulation of two stroke SI engine will also be introduced tothe students. At the end of the course the students will have command over simulation of IC engineprocess.

UNIT I INTRODUCTION: 9

Advantages of computer simulation, Classification of engine models. Intake and exhaust flow models– Quasi steady flow - Filling and emptying - Gas dynamic Models. Thermodynamic based in cylindermodels. Step by step approach in SI engine simulation.

UNIT II COMBUSTION AND STOICHIOMETERY: 9

Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air, excess air and stoichiometricair required for combustion. Conversion of volumetric analysis to mass analysis.Introduction,complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressureadiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state.

UNIT III COMPUTER SIMULATION OF SI ENGINE WITH FUEL AIR CYCLE: 9

SI Engine simulation with air as working medium, deviation between actual and ideal cycle. Fuel aircycle analysis - Temperature drop due to fuel vaporization, full throttle operation, work output andefficiency calculation, part-throttle operation, engine performance at part throttle, super chargedoperation. SI Engines simulation with progressive combustion.Wiebe's law combustion analysis.

UNIT IV COMPUTER SIMULATION OF SI ENGINE WITH GAS EXCHANGE PROCESS 9

Introduction, gas exchange process, Heat transfer process, friction calculations, compression ofsimulated values, validation of the computer code, engine performance simulation, pressurecrankangle diagram, brake power, brake thermal efficiency, effect of speed on performance.

UNIT V COMPUTER SIMULATION OF CI ENGINE 9

Zero, one and multizone models for diesel engine combustion.Double Wiebe'sLaw analysis fordiesel combustion.Heat release model and different heat transfermodels.Equilibriumcalculations.Parametric studies on simulated engine performance.

TOTAL: 45 PERIODS

TEXTBOOK:

1. **Ganesan.V**. "Computer Simulation of spark ignition engine process", Universities Press (I) Ltd,Hyderbad, 1996.

REFERENCES

1. John. B. Heywood, 'Internal Combustion Engines'", Tata McGraw Hill Co., Newyork, 1988.
2. Benson.R.S., Whitehouse.N.D., "Internal Combustion Engines", Pergamon Press, oxford, 1979
3. Ramoss.A.L., "Modelling of Internal Combustion Engines Processes", McGraw Hill Publishing Co.,1992
4. Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley & Sons, NewYork, 1986.

AM15A2 TWO AND THREE WHEELERS 3 0 0 3

OBJECTIVE:

The objective of this course is to make the students to know and understand the constructionaldetails, operating characteristics and design aspects of Two and Three wheelers.

UNIT I INTRODUCTION: 9

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

UNIT II POWER UNITS, IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS 9

2 stoke and 4 stoke engines. Design criteria for engines – design of cylinders, cylinder head, coolingfins, crank case, connecting rod and crank shaft. Carburettor types and design. Battery coil ignition,magneto ignition and electronic ignition. Lighting and other electrical systems.

UNIT III CLUTCHES AND TRANSMISSION 9

Types of clutches.Design of clutch system.Gears for two and three wheelers.Design of gear box andgear change mechanism. Belt, chain and shaft drive. Free wheeling devices, starting systems.

UNIT IV FRAMES, SUSPENSION, WHEELS AND TYRES 9

Types of frames.Wheel frames- construction design of frames for fatigue strength,torsionalstiffnessand lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details ofwheel and tyres.

UNIT V THREE WHEELERS 9

Auto rickshaws, different types, Pick-Ups and delivery type vehicle, frames and transmission, wheeltypes, wheel mountings attachment, tyre types. Brake systems.

TOTAL: 45 PERIODS

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, Mopeds', 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.

AM15A3 THEORY OF FUELS AND LUBRICANTS 3 0 0 3

OBJECTIVES

To understand the properties of fuels and lubricants for the design and operation of the I.C engines

UNIT I MANUFACTURE OF FUELS AND LUBRICANTS : 9

Structure of petroleum, refining process, fuels, thermal cracking, catalytic cracking, polymerization,alkylation, isomerisation, blending, products of refining process. Manufacture of lubricating oil basestocks, manufacture of finished automotive lubricants.

UNIT II THEORY OF LUBRICATION : 9

Engine friction: introduction, total engine friction, effect of engine variables on friction, hydrodynamiclubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of thelubrication system, introduction to design of a lubricating system.

UNIT III PROPERTIES AND TESTING OF LUBRICANTS 9

Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants,synthetic lubricants, classification of lubricating oils, properties of lubricating oils, tests on lubricants.Grease, classification, properties, test used in grease.

UNIT IV PROPERTIES AND TESTING OF FUELS 9

Thermo-chemistry of fuels, properties and testing of fuels, relative density, calorific value, flash point,fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, pour point,flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosionetc.

UNIT V ADDITIVES FOR LUBRICANTS AND FUELS 9

Additive - mechanism, requirements of additive, petrol fuel additives, diesel fuel additives – Additivesand additive mechanism, for lubricants. Introduction to Nano fluids.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ganesan.V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi,2003.
2. M.L. Mathur, R.P.Sharma "A course in internal combustion engines", Dhanpatrai publication,2003.
3. Obert.E.F "Internal Combustion Engineering and Air Pollution", International book Co., 1988.

REFERENCES

1. Brame, J.S.S. and King, J.G. – Fuels – Solids, Liquids, Gaseous.
2. Francis, W – Fuels and Fuel Technology, Vol. I & II
3. Hobson, G.D. &Pohl.W- Modern Petroleum Technology

4. A.R.Lansdown – Lubrication – A practical guide to lubricant selection – Pergamon press – 1982.
5. Raymond.C.Gunther – Lubrication – Chilton Book Co., - 1971.

AM15A4 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 specialvehicles such as Bulldozers, Ditchers, Bucket excavators, farm equipments, military vehicles etc. Atthe end of the course, the students can have a better understanding of the application of the specialtypes of vehicles in the excavation of earth.

UNIT I EARTH MOVING AND CONSTRUCTIONAL EQUIPMENTS: 9

Construction details, capacity and applications of earthmovers for dumpers, front-end loaders,bulldozers, excavators, backhoe loaders, scrappers, motor graders etc. criteria for selection of primemover for dumpers and front end loaders based on vehicle performance characteristics.

UNIT II POWER TRAIN CONCEPTS : 9

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 AND FEATURES : 9

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

UNIT IV SPECIAL PURPOSE VEHICLES FOR INDUSTRIAL APPLICATIONS 9

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

UNIT V FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES 9

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

TOTAL: 45 PERIODS

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.

AM15A5 INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES3 0 0 3

OBJECTIVE:
Study of the theory, construction and operation of different measurement technology, instrumentstransducers and their application in automotive industry.

UNIT I MEASUREMENT SYSTEMS 9
Static and Dynamic Measurement systems-importance of measurement system – methods ofmeasurement -applications - characteristics of measuring system-static and dynamic characteristicsof measuring system – Analysis of experimental detail, Error analysis-types of errors-limiting errors.

UNIT II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES 9
Transducers for Automotive Applications – Amplifiers-Classifications and application in automobile –filters -types – Data Acquisition system - analog and digital type DAS- Indicators, Printers anddisplay device –Signal Analyzing with example of automobile applications.

UNIT III MECHANICAL MEASUREMENT 9
Instrumentation for Measuring Weight, Force, torque , pressure, power, temperature, fluid flow andspecial methods , vibration piezo electric effect, rotational speed .Measuring Velocity, accelerationand angular motion with respect to automobile applications.

UNIT IV ENGINE EXPERIMENTAL TECHNIQUES 9
I.S Code for Engine testing – Instrumentation for performance testing of engine, Instrumentation forResearch and development, Instrumentation for noise, vibration, in cylinder gas flow, flametemperature Dynamic Cylinder pressure measurements.

UNIT V VEHICLE EXPERIMENTAL TECHNIQUES 9
Laboratory tests- test tracks - Endurance Tests- crash tests- wind tunnel tests- Dynamic corneringfatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations.Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteriaand performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test,procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test,performance requirements.

TOTAL: 45 PERIODS

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, NewDelhi, 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 PublishingCo., Ltd., 1990

AM15A6 ENGINE MANAGEMENT SYSTEMS L T P C 3 0 0 3

OBJECTIVE:
To explain the principle of engines electronic management system and different sensors used in thesystems.

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS: 9
Components for electronic engine management system, open and closed loop control strategies, PIDcontrol, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control.Switches, active resistors, Transistors, Current mirrors/amplifiers, Voltage and current references,Comparator, Multiplier.Amplifier, filters, A/D and D/A converters.

UNIT II SENSORS AND ACTUATORS : 9
Inductive, Hall Effect, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, massair flow, crank shaft position, cam position, engine speed sensor, exhaust oxygen level (two step,linear lambda and wideband), knock, manifold temperature and pressure sensors. Solenoid, relay(fourand five pin), stepper motor.

UNIT III SI ENGINE MANAGEMENT: 9
Layout and working of SI engine management systems. Group and sequential injection techniques.Advantages of electronic ignition systems. Types of solid state ignition systems and their principle ofoperation, Contactless (BREAKERLESS) 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.Electronically controlled Unit Injection system.Common rail fuel injection system.Working ofcomponents 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, decelerationfuel cutoff. Fuel control maps, open loop and closed loop control – Integrated engine control system,Electromagnetic compatibility – EMI Suppression techniques – Electronic dash board instruments –Onboard diagnosis system.

TOTAL: 45 PERIODS

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.

AM15A7 COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

UNIT I INTRODUCTION: 9

Basic concepts of fluid flow-derivation of the governing equations, conservation of mass, momentum andenergy.Mathematical classification of flow - hyperbolic, parabolic, elliptic and mixed flow types.

UNIT II DISCRETISATION: 9

Finite difference method - forward, backward and central difference schemes, explicit and implicitmethods. Properties of numerical solution methods - stability analysis, error estimation, difference between the FDM and FVM methods.

UNIT III INTRODUCTION TO GRID GENERATION: 9

Choice of grid, grid oriented velocity components, cartesian velocity components,staggered and collocated arrangements, adaptive grids.

UNIT I V CFD TECHNIQUES: 9

Lax - Wendroff technique - MacCormack's technique, relaxation technique. Artificial viscosity,ADItechnique, Pressure correction technique, SIMPLE algorithm. Upwind schemes - flux vector splitting.

UNIT V TURBULENCE MODELING: 9

Turbulence energy equation- one-equation model, the k-_ model, the k- _ model.Practicalproblem solving using CFD packages.

TOTAL 45 PERIODS

REFERENCES:

1. Muralidhar K and Sundararajan T, "Computational Fluid Flow and Heat Transfer", Narosa Publications, New Delhi, 2003.
2. Chung T J, "Computational Fluid Dynamics", Cambridge University Press, London, 2002.
3. Versteeg H K and Malalasekara W, "An Introduction to Computational Fluid Dynamics - The Finite Volume Method',Longman, 1995.
4. John D Anderson, " Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, , New York, 1995.
5. David C Wilcox, "Turbulence Modeling for CFD", DCW Industries, Inc., 1993.

AM15A8 DESIGN OF BRAKES, STEERING AND RUNNING GEARS 3 0 0 3

UNIT I DESIGN OF BRAKING SYSTEM: 9

Function, stopping time and distance, weight transfer during braking, brake actuatingmechanisms – mechanical, hydraulic and pneumatic, disc and drum brakes - design and analysis of brake shoes and frictionpads.

UNIT II DESIGN OF STEERING SYSTEM: 9

Functions, requirements, conditions for true rolling – Ackerman and Davis mechanisms, rollcentre and roll axis. Steering geometry – camber, castor, king pin inclination, toe-in, toe out, steering angle and steering ratio.Steering gear boxes – re-circulating ball, worm and worm wheel, rack and pinion.Steering linkages, steering kinematics.

UNIT III DESIGN OF RUNNING GEARS: 9

FRAME: Types of frames, various forces acting on frames, different sections, materials, crash safety. **AXLES:** Purpose of axle settings, wheel base and track. Front axle - functions, forces acting, cross sections. Rear axles –functions, forces acting, different types and design, simple design calculations.

UNIT IV SUSPENSION SYSTEM: 9

Types of suspension, factors affecting ride quality, suspension springs. Shock absorbers, differentsuspension systems, suspension spring design, gyroscopic effects.

UNIT V SELECTION OF WHEELS AND TYRES: 9

Tyre requirements, selection of tyres, wheels and mountings – lateral force andfriction co-efficient, self aligning torque and caster offset, overturning moment, torque steer effects.

TOTAL 45 PERIODS

REFERENCES:

1. Giri N K, “Automobile Mechanics”, Khanna Publishers, 2006.
2. Donald Bastow, Geoffry Howard and John P.Whitehead “Car Suspension and Handling”, 4th edition, SAE2004.
3. Julian Happian-Smith, “An Introduction to Modern Vehicle Design”, Butterworth Heinemann Publishers, 2002.
4. Reimpell J, Stoll H, Betzler J W, “The Automotive Chassis”, SAE International, Second Edition, 2001.
5. Rudolf Limpert, “Brake Design and Safety”, SAE International, Second Edition, 1999.
6. John Fenton, “Handbook of Automotive Power trains and Chassis Design”, Professional Engineering Publishing, 1998.
7. Lukin R, Gasparyants G, Rodionov V, “Automobile Chassis Design and Calculations”, MIR Publishers, Moscow, 1989.

AM15A9 NOISE, VIBRATION AND HARSHNESS CONTROL 3 0 0 3

UNIT I EMISSIONS FROM SI AND CI ENGINES: 9

Emission formation in SI and CI engines – effect of pollution on human health.Emission norms - EURO &Bharath norms, emission regulations and emission test cycles. - causes for the increase inemissions in engines, engine modifications to reduce emissions, role of engine fuel in engine emission, effect of fuel propertiesand additives on emissions, use of alternate fuels.

UNIT II EMISSION CONTROL TECHNIQUES: Crank case emission control, fuel evaporation & control, EGR, intake temp control, airinjected exhaust, thermal reactors, catalytic converters – types, tuning of mechanical systems - A/F ratio control.

UNIT III INSTRUMENTATION FOR EMISSION MEASUREMENT: 9

NDIR analyzer, flame ionization detectors, chemiliuminescentanalyzer, smoke meters, gas chromatograph.

UNIT IV NOISE AND NOISE CONTROL: 9

Sound wave and its propagation, sound measurement, subjective response and ratings.Reverberation time and absorption of sound. Identification of noise sources, quantification, noise measuring instruments,control of air borne noise - use of noise absorber, barrier, different materials, criteria for the selection of materials, control ofstructure borne noise - treatments for vibration damping materials for hood liner and head liner, evaluation of naturalfrequencies of critical members, resonance, ill effects of resonance. sound isolation-machine enclosures, silencers andmufflers.

UNIT V VIBRATION MEASUREMENT AND CONTROL: 9

Measurement of vibration, FFT analyzer. Methods of vibration control -excitation reduction at source, balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection ofstructural materials- viscoelastic polymers, vibration absorbers- tuned absorber, tuned and damped absorber (qualitativetreatment only), untuned viscous damper, vibration isolation.

TOTAL: 45 PERIODS

REFERENCES:

1. John Fenton, “Handbook of Automotive Power Train and Chassis Design”, SAE 1998.
2. Rao S S, "Mechanical Vibrations", Addison Wesley Longman, New Delhi, 1995.
3. Heinz Heisler, “Advanced Engine Technology”, SAE 1995.
4. “Automobiles and pollution” SAE Transaction, 1995.
5. Seto, “Mechanical Vibrations ", Schaum Outline Series, McGraw Hill Book Company, New York, 1990.
6. Springer and Patterson, “Engine Emission”, Plenum Press 1990.
7. Thomson W T, "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.
8. Ashok Kumar Mallik, “Principles of Vibration control”, Affiliated East-West Press (P) Ltd., New Delhi, 1990.
9. Grover G K, "Mechanical Vibrations ", New Chand and Brothers, Roorkey, 1989.
10. Tse Morse and Hinkle, “Mechanical Vibration”, Prentice Hall of India Ltd., New Delhi,1987.

AM15B1 AUTOMOTIVE COMPONENT MANUFACTURING 3 0 0 3

UNIT I: ENGINE COMPONENTS: **9**

Casting of engine block - conventional and expendable pattern, machining of engine blocks in machining center. Preparation of casting for cylinder heads, forging of crank shaft, connecting rod and gudgeon pins, machining and heat treatment, casting of piston by gravity casting, squeeze casting, machining and finishing, upset forging of valves, heat treatment and surface improvement, cylinder liners and piston ring manufacturing. Engine bearing manufacturing.

UNIT II: TRANSMISSION COMPONENTS: 9

Manufacturing of friction plates using conventional blanking and fine blanking. Casting of gear box casing, precision forging of gears, gear hobbing, shaping, powder metallurgy, orbital forming of spur, helical, and bevel gears, hypoid gears, heat treatment and finishing. Continuous casting of propeller shaft, extrusion of propeller shaft, extrusion dies, heat treatment and surface hardening of propeller shaft, composite propeller shaft manufacturing. Forging of rear axles, casting of rear axle casing, wheels, brake drum, tyre manufacturing.

UNIT III: BODY COMPONENTS: 9

Introduction, thermoforming and hydro forming, press forming, welding of body panels, resistance welding and other welding processes. Introduction, principle of injection moulding, injection moulding of instrument panel, moulding of bumpers, reinforced reaction injection moulding, tooling and tooling requirements, manufacture of metal/polymer/metal panels. Adhesives and sealants, leaf spring manufacturing, composite leaf springs, wrap forming of coil springs.

UNIT IV: SURFACE COATINGS: 9

Chemical vapour deposition, physical vapour deposition, sol-gel processing, spraying, plating, painting, paint booth, electro plating of metals, metal coatings, case hardening, thermal spraying, vapour deposition, electro plating , electro-less plating, anodizing .

UNIT V: ELECTRICAL COMPONENTS: 9

Starter motor, alternator, regulator, battery, lamps, control switches, electronic gauges, power windows, power steering, head light and other external lights, wind shield wipers, defroster, switches and switch pads, wiring harness.

TOTAL: 45 PERIODS

REFERENCES:

1. Philip F. Ostwald & Jairo Munuz, “Manufacturing Processes and Systems”, John Wiley & Sons, New York, 1998.
2. Degarmo E.P., “Materials and process in Manufacturing”, Macmillan Publishing Co., 1997.
3. Heldt P.M., “High Speed Combustion Engines”, Oxford IBH publishing Co., Calcutta, 1996.
4. Kalpakjian,“Manufacturing and Engineering and Technology”, Addison Wesloy, Publishing Company, 1995.
5. Sanjay K Mazumdar, “Composites Manufacturing”, CRC Press, NY, 2003

AM15B2 AUTOMOTIVE MATERIALS 3003

UNIT I:CLASSIFICATION: 9

Metals, ceramics, glasses, elastomers, polymers, composites, smart materials, members of each class,nano science materials, material properties viz mechanical, thermal, wear, corrosion oxidation.

UNIT IL:SELECTION OF MATERIALS: 9

Selection strategy, property limits and material indices, function objectives and constraints,performance maximizing criteria.Modulus - density, strength – density, modulus – strength, specific stiffness and specificstrength, fracture toughness, modulus fracture etc.Shape factors, elastic extrusion, elastic body and twisting, failure, bending andtwisting, axial loading and column buckling, efficiency of standard sections, material limits for shape factors, microscopic shapeand shape factors.

UNIT III:FERROUS AND NON FERROUS ALLOYS: 9

Types of cast irons, properties, structures, compositions and applications, plain carbon steels, lowalloy steels and effects of alloying elements, high alloy steels, stainless steel types, castability, formability, machinability,hardenability and weldability of the material, high temperature steels and super alloys. Alloys of copper, aluminium, nickel, magnesium, titanium, lead, tin, zinc - compositions, heattreatments, structures, properties, applications, castability, formability, machinability, hardenability andweldability.

UNIT IV:BODY MATERIALS: 9

Steels – HSLA, aluminium alloys, magnesium alloys, plastics and ceramics, ULSAB, ULSAS, DP, IF,TRIP Steels. Types of composites, volume fraction - lamellar composites production and properties of whiskers of siliconcarbide, graphite, fibres of zirconia, alumina and boron nitride - metal filaments - boron filaments - glass fibres applications.

UNIT V:NON-METALLIC / ELECTRICAL AND MAGNETICMATERIALS: 9

Ceramics, refractories, abrasives, enamels, cement – glasses, polymers: thermosetting andthermoplastics, types of polymerisation, elastomers, electrical conducting polymers.P and N type semiconductors, single crystals, soft and hard magnets,superconductors, MEMS materials, nano science materials, smart materials, shape memory alloys.

TOTAL: 45 PERIODS

REFERENCES:

1. Michael F. Ashby, “Materials Selection in Mechanical Design”, Butterworth Heinemann, 2005.
2. Daniel Yesudian C., “Materials Science and Metallurgy”, Scitech Publications (India), 2004.
3. Polmear I.J., “Light Alloys”, Arnold Publishers, 1995.
4. Swarup D. and Saxena M.N., "Elements of Metallurgy", Rastogi Publishers, Meerut, 1994.
5. Srinivasan N.K. and Ramakrishnan S.S., "The Science of Engineering Materials", Oxford and IBH Pub. Co., New Delhi ,1993.
6. Van Vlack L.H., "Elements of Materials Science and Engineering", Addison Wesley, New York, 1991.
7. Guy A.G," Elements of Physical Metallurgy", Oxford & IBH Pub. Co., 1990.

AM15B3 ELECTRIC AND HYBRID VEHICLES 3 0 0 3

UNIT I: ELECTRIC VEHICLES: 9

Layout of an electric vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system, components, electronic control system.

UNIT II: HYBRID VEHICLES: 9

Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design efficiency and cost comparison.

UNIT III: ELECTRIC PROPULSION SYSTEMS: 9

DC motors, AC motors, permanent magnet motors, brushless DC and reluctance motors, characteristics, regenerative braking, efficiency and cost comparison.

UNIT IV: MOTOR CONTROLLERS AND CONTROL SYSTEMS: 9

Control system principles, speed and torque control – DC motors and AC motors, DC generators, AC generators, voltage and frequency regulations, efficiency and cost comparison.

UNIT V: ENERGY STORAGES: 9

Electromechanical batteries- types of batteries – lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultra capacitors. Fuel cell, construction, working, equations, possible fuel sources, fuel reformer, design. Solar cars- photovoltaic cells, tracking, efficiency and cost comparison.

TOTAL: 45 PERIODS

REFERENCES:

1. MehrdadEhsani, YiminGao, sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles:Fundamentals, Theory and Design”, CRS Press, 2004.
2. James Larminie and John Loury, “Electric Vehicle Technology-Explained”, John Wiley & Sons Ltd., 2003.
3. SandeepDhameja, “Electric Vehicle Battery Systems”, Butterworth –Heinemann, 2002.
4. Ronald K Jurgen, “Electric and Hybrid – Electric Vehicles”, SAE, 2002.
5. Ron Hodkinson and John Fenton, “Light Weight Electric/Hybrid Vehicle Design”, Butterworth-Heinemann, 2001.

AM15B4 AUTOMATIC TRANSMISSION 3 0 0 3

UNIT I:INTRODUCTION: 9

Principles of automatic transmission, advantages, limitations, main components of automatic transmission,hydraulic control system, pumps, automatic variable delivery pump.

UNIT II:CENTRIFUGAL CLUTCHES AND FLUID COUPLING: 9

Principle of centrifugal clutches, comparison between conventional andcentrifugal clutches, centrifugal clutches used in two wheelers, principles of fluid coupling, principles of energy transfer, workingfluid, requirements, fluid coupling characteristics, fluid coupling with conventional gear boxes.

UNIT III:OVERDRIVES: 9

Overdrives - overdrive operations, going into overdrive, coming out of overdrive, locking out the overdrive,advantages, WARNER automatic overdrives, speed sensitive clutch, locking arrangements for sun gear, Planetary gear train,typical gear ratios, drawbacks of over drives, reverse lock up, over drive lubrication.

UNIT IV:HYDRODYNAMIC TORQUE CONVERTERS: 9

Introduction to torque converters, comparisons between fluid coupling andtorque converters, performance characteristics, slip, principles of torque multiplication, 3 and 4 phase torque converters, typicalhydrodynamic transmission.

UNIT V:HYDROSTATIC DRIVES: 9

Principles of hydrostatic drives, different systems of hydrostatic drives, constant displacement pumpand constant displacement motor, variable displacement pump and constant displacement motor and variable displacementmotor, variable displacement pump and variable displacement motor, applications, plunger type pump and plunger type motor,

advantages and limitations, typical hydrostatic drives, Janney hydrostatic drives, Nel Glasgow transmission-hydrostatic shuntdrives.

TOTAL: 45 PERIODS

REFERENCES:

1. Jack Erjavec, "Automatic Transmissions", Delmar Publishers,1st edition,2005.
2. Tom Birch and ChnckRockmood, "Automatic Transmissions and Transaxles", Prentice Hall,1st edition,2002.
3. Mathias F Brejeha, "Automatic Transmission", Prentice Hall,1998.
4. William Turney, "Automatic Transmissions and Transaxles", Chek Chart Publishers,1997.
5. Tucker H F, "Automatic Transmission", Van Nostrand Reinhold Company,1980.

AM15B5 FINITE ELEMENT METHODS IN AUTOMOBILE ENGINEERING

3 0 0 3

OBJECTIVE:

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

UNIT I INTRODUCTION 9

Engineering design analysis-meaning and purpose, steady state, propagation and transient problems.Concepts of FDM, FEM, FVM. Steps involved in FEM. Applicability of FEM to structural analysis, heattransfer and fluid flow problems. Advantages and limitations of FEM. Test for convergence.Elementchoice.Commercial finite element packages.Solution of Boundary value problem – Integralformulation for numerical solution - Variational methods - Minimum total potential energy formulation.

UNIT II 1D ELEMENTS 9

Use of bar and beam elements in structural analysis. Bar Element – Stiffness matrix formulation bydirect and polynomial methods. Boundary condition and assemblage concepts. Beam elementcharacteristics matrix. Global, local, natural coordinates.

UNIT III 2D ELEMENTS 9

Rectangular elements - Quadratic quadrilateral elements - Linear Triangular elements - 2D elementsapplications for plane stress, plane strain and axi-symmetric problems. Treatment of boundarycondition. Mesh generation techniques. Numerical integration schemes.Iso Parametric elements.Introduction to 3D Elements.

UNIT IV STRUCTURAL AND DYNAMIC ANALYSIS 9

1D & 2D problems in Solid mechanics.Dynamics problems representation in FE. Free vibrationproblem formulation. Torsion of non circular shaft - axisymmetric problem. Case Studies likeStructural analysis of Chassis Frame, Whirling speed of propeller shaft, contact analysis of gears,modal analysis of suspension system, impact, crash worthiness etc.

UNIT V HEAT TRANSFER ANALYSIS AND FLOW ANALYSIS 9

1D & 2D problems in fluid mechanics and heat transfer by conduction and convection. Transientthermal analysis. Case Studies like Heat transfer analysis of piston, fins.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Segerlind,L.J., Applied Finite Element Analysis, Second Edition, John Wiley and Sons Inc., NewYork, 1984
2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and applicationsof 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 IndiaLtd., 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.