ANNA UNIVERSITY, CHENNAI
AFFILIATED COLLEGES
REGULATIONS – 2017
M.E. AUTOMOBILE ENGINEERING
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

I. Students will excel in their professional career in automobile industry and research with highest professional and ethical standards to their activities by acquiring knowledge in basic engineering, mathematics, science and automobile engineering.

II. Students will exhibit professionalism, team work in their chosen profession and adapt to current trends, technologies and industrial scenarios by pursuing lifelong learning.

PROGRAMME OUTCOMES (POs):

1. Graduate will demonstrate strong basics in mathematics, science and Engineering
2. Graduate will demonstrate the ability to design and conduct Experiments, as well as to analyze and interpret data.
3. Graduate will demonstrate the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and Safety, manufacturability and sustainability.
4. Graduate will become familiar with modern Engineering tools and analyse the problems within the domains of Automobile Engineering as the members of multidisciplinary teams.
5. Graduate will acquire the capability to identify, formulate and solve complex engineering problems related to Automobile Engineering
6. Graduate will demonstrate and understanding of professional and ethical responsibility with reference to their career in the field of Automobile Engineering
7. Graduate will be able to communicate effectively both in verbal non-verbal forms
8. Graduate will be trained towards developing the impact of development of Automobile engineering on global, economic environment and societal context
9. Graduate will be capable of understanding the value for life-long learning
10. Graduate will demonstrate knowledge of contemporary issues focusing on the necessary to develop new material, design, and engineering practice in the field of Automobile Engineering
11. Graduate will demonstrate the ability to use the techniques, skills and Modern engineering tools necessary for engineering practice in the field of Automobile Engineering
12. Graduate will have a firm scientific, technological and communication base that helps them either to find a desire placement or to become an Entrepreneur and explore their knowledge in their field.
13. Graduate will be capable of doing higher studies and research in inter and multidisciplinary areas.

CORRELATION BETWEEN POs AND PEOs

Sl. No.	Programme Outcomes (POs)	Programme Educational Objectives	
		PEO I	PEO II
1.	Graduate will demonstrate strong basics in mathematics, science and Engineering	✓	
2.	Graduate will demonstrate the ability to design and conduct Experiments, as well as to analyze and interpret data.	✓	✓
3.	Graduate will demonstrate the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and Safety, manufacturability and sustainability.	✓	✓
4.	Graduate will become familiar with modern Engineering tools and analyse the problems within the domains of Automobile Engineering as the members of multidisciplinary teams.	✓	✓
5.	Graduate will acquire the capability to identify, formulate and solve complex engineering problems related to Automobile Engineering	✓	✓
6.	Graduate will demonstrate and understanding of professional and ethical responsibility with reference to their career in the field of Automobile Engineering	✓	
7.	Graduate will be able to communicate effectively both in verbal nonverbal forms	✓	✓
8.	Graduate will be trained towards development of Automobile engineering environment and societal context	✓	
9.	Graduate will be capable of understanding the value for life-long learning		✓
10.	Graduate will demonstrate knowledge of contemporary issues focusing on the necessary to develop new material, design, and engineering practice in the field of Automobile Engineering	✓	✓
11.	Graduate will demonstrate the ability to use the techniques, skills and Modern engineering tools necessary for engineering practice in the field of Automobile Engineering	✓	✓
12.	Graduate will have a firm scientific, technological and communication base that helps them either to find a desire placement or to become an Entrepreneur and explore their knowledge in their field.	✓	✓
13.	Graduate will be capable of doing higher studies and research in inter and multi-disciplinary areas.	✓	✓

CORRELATION BETWEEN COURSES AND POs

Year	Semester	Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
1	1	Automotive Chassis	☑	☑			☑			☑	☑	☑	☑	☑	☑
		Automotive Engines and Subsystems	☑				☑			☑	☑	☑	☑	☑	☑
		Automotive Transmission	☑				☑			☑	☑	☑	☑	☑	☑
		Advanced Numerical Methods	☑	☑	☑		☑			☑	☑	☑	☑	☑	☑
		Professional Elective I													
		Professional Elective II													
		Engine and Chassis Laboratory	☑				☑	☑	☑	☑	☑	☑	☑	☑	☑
	2	Engine Management Systems	☑	☑	☑	☑	☑			☑		☑			
		Automotive Pollution and Control	☑	☑	☑	☑	☑			☑	☑	☑	☑		☑
		Electric and Hybrid Vehicles	☑	☑	☑	☑		☑		☑	☑	☑			☑
		Vehicle Dynamics	☑	☑	☑	☑	☑			☑	☑	☑			☑
		Professional Elective III													
		Professional Elective IV													
		Automotive Electrical and Electronics Laboratory	☑	☑	☑	☑	☑	☑	☑	☑		☑			☑
2	3	Chassis Management Systems	☑	☑	☑	☑	☑			☑		☑			
		Professional Elective V													
		Professional Elective VI													
		Computer Aided Vehicle Design Laboratory	☑	☑	☑	☑	☑		☑	☑	☑	☑	☑	☑	☑
		Project Work Phase I	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	4	Project Work Phase II	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

REGULATIONS - 2017

M.E. AUTOMOBILE ENGINEERING

CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AM5101	Automotive Chassis	PC	5	3	2	0	4
2.	AM5102	Automotive Engines and Subsystems	PC	3	3	0	0	3
3.	AM5103	Automotive Transmission	PC	3	3	0	0	3
4.	MA5153	Advanced Numerical Methods	FC	5	3	2	0	4
5.		Professional Elective I	PE	3	3	0	0	3
6.		Professional Elective II	PE	3	3	0	0	3
PRACTICAL								
7.	AM5111	Engine and Chassis Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**4**	**4**	**22**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AM5201	Engine Management Systems	PC	3	3	0	0	3
2.	AM5202	Automotive Pollution and Control	PC	3	3	0	0	3
3.	AM5203	Electric and Hybrid Vehicles	PC	3	3	0	0	3
4.	AM5204	Vehicle Dynamics	PC	3	3	0	0	3
5.		Professional Elective III	PE	3	3	0	0	3
6.		Professional Elective IV	PE	3	3	0	0	3
PRACTICAL								
7.	AM5211	Automotive Electrical and Electronics Laboratory	PC	4	0	0	4	2
8.	AM5212	Technical Seminar - I	EEC	2	0	0	2	1
			TOTAL	**24**	**18**	**0**	**6**	**21**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AM5301	Chassis Management Systems	PC	3	3	0	0	3
2.		Professional Elective V	PE	3	3	0	0	3
3.		Professional Elective VI	PE	3	3	0	0	3
PRACTICAL								
4.	AM5311	Computer Aided Vehicle Design Laboratory	PC	4	0	0	4	2
5.	AM5312	Technical Seminar - II	EEC	2	0	0	2	1
6.	AM5313	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**27**	**9**	**0**	**18**	**18**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	AM5411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	24	**0**	**0**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF DEGREE = 73

FOUNDATION COURSES (FC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA5153	Advanced Numerical Methods	FC	4	3	2	0	4

PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AM5101	Automotive Chassis	PC	5	3	2	0	4
2.	AM5102	Automotive Engines and Subsystems	PC	3	3	0	0	3
3.	AM5103	Automotive Transmission	PC	3	3	0	0	3
4.	AM5111	Engine and Chassis Laboratory	PC	4	0	0	4	2
5.	AM5201	Engine Management Systems	PC	3	3	0	0	3
6.	AM5202	Automotive Pollution and Control	PC	3	3	0	0	3
7.	AM5203	Electric and Hybrid Vehicles	PC	3	3	0	0	3
8.	AM5204	Vehicle Dynamics	PC	3	3	0	0	3
9.	AM5211	Automotive Electrical and Electronics Laboratory	PC	4	0	0	4	2
10.	AM5301	Chassis Management Systems	PC	3	3	0	0	3
11.	AM5311	Computer Aided Vehicle Design Laboratory	PC	4	0	0	4	2

SEMESTER I (Elective I & II)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	AM5001	Advanced Thermodynamics for Automobile Engineers	PE	3	3	0	0	3
2	AM5002	Alternative Fuels	PE	3	3	0	0	3
3	AM5003	Hydraulic and Pneumatic Systems	PE	3	3	0	0	3
4	AM5004	IC Engine process Modeling	PE	3	3	0	0	3
5	AM5005	Production of Automobile Components	PE	3	3	0	0	3
6	AM5006	Theory of Fuels and Lubricants	PE	3	3	0	0	3
7	AM5007	Vehicle Design and Data Characteristics	PE	3	3	0	0	3
8	EY5151	Fluid Mechanics and Heat Transfer	PE	3	3	0	0	3

SEMESTER II (Elective III & IV)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	AM5008	Automotive Air Conditioning Systems	PE	3	3	0	0	3
2	AM5009	Combustion Thermodynamics and Heat	PE	3	3	0	0	3
3	AM5010	Vehicle Body Engineering	PC	3	3	0	0	3
4	AM5011	Finite Element Methods in Automobile Engineering	PE	3	3	0	0	3
5	AM5012	Simulation of Vehicle systems	PE	3	3	0	0	3
6	AM5013	Two and Three Wheelers	PE	3	3	0	0	3
7	TE5071	Computational Fluid Dynamics for Thermal Systems	PE	3	3	0	0	3
8	AM5014	Automotive Electrical Technology	PE	3	3	0	0	3

SEMESTER III (Elective V & VI)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	AM5015	Automotive Aerodynamics	PE	3	3	0	0	3
2	AM5016	Automotive Safety	PE	3	3	0	0	3
3	AM5017	Instrumentation and Experimental Techniques	PE	3	3	0	0	3
4	AM5018	Special Types of Vehicles	PE	3	3	0	0	3
5	AM5019	Vehicle Maintenance	PE	3	3	0	0	3
6	AM5020	Transport Management	PE	3	3	0	0	3
7	MF5072	Research Methodology	PE	3	3	0	0	3
8	AM5021	Automotive Testing and Certification	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AM5212	Technical Seminar - I	EEC	2	0	0	2	1
2.	AM5312	Technical Seminar - II	EEC	2	0	0	2	1
3.	AM5313	Project Work Phase I	EEC	12	0	0	12	6
4.	AM5411	Project Work Phase II	EEC	24	0	0	24	12

AM5101 AUTOMOTIVE CHASSIS

L	T	P	C
3	2	0	4

OBJECTIVES:

- Study of the Constructional details and Theory of important drive line, Structural, Steering, Braking and Suspension Systems of Automobiles. Problem–Solving in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems are to be done.

UNIT I LAYOUT, FRAME, FRONT AXLE AND STEERING SYSTEM 13

Basic construction of chassis, Types of Chassis layout, with reference to Power Plant location and drive, various, types of frames, Loads acting on vehicle frame, materials for frames, Testing of frames, Types of Front Axles and Stub Axles, Front Wheel Geometry – Castor, Camber, King Pin Inclination and Toe–in, Toe-out. Condition for True Rolling Motion. Ackerman's and Davis Steering Mechanisms, Steering Linkages, Different Types of Steering Gear boxes, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power–Assisted Steering. Steering of Crawler Tractors.

UNIT II DRIVE LINE, FINAL DRIVE AND DIFFERENTIAL 12

Driving Thrust and its effects, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, transfer case, Propeller Shaft, Slip joints, Universal Joints, Constant Velocity Universal Joints, Final drive, types of final drive – Worm and Worm wheel, straight bevel gear, spiral bevel gear, helical gear and hypoid gear final drive. Double reduction and twin speed final drives, Differential principle, Constructional details of differential unit, Differential housings, Non–Slip differential, Differential locks, Final drive of Crawler Tractors.

UNIT III REAR AXLES, WHEELS, RIMS AND TYRES 11

Construction of rear axles, Types of Loads acting on rear axles, Full Floating, Three – Quarter Floating and Semi–Floating Axles, Types, Multi axle vehicles. Constructional Details of Different Types of axle Housings, Wheels and Rims. Tyres – Types and constructional details.

UNIT IV SUSPENSION SYSTEM 12

Requirements of Suspension System, Types of Suspension – Constructional details and characteristics of Single Leaf, Multi–Leaf spring, Coil spring and Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension, Independent Suspension System, Shock Absorbers.

UNIT V BRAKE SYSTEM 12

Need for Brake system, Stopping Distance, Time and Braking Efficiency, Effect of Weight Transfer during Braking, Leading and Trailing Shoes, Braking Torque, Types and constructional details – Drum Brakes and disc brakes, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Servo Brakes, Retarders, Anti–Lock Braking System.

TOTAL : 60 PERIODS

OUTCOMES:

At the end of this course the student should be able to

- Understand of the Constructional details of chassis, know the important drive line, Structural, Steering, Braking and Suspension Systems of Automobiles.

- Improve the Problem–Solving skill in Steering Mechanism, Propeller Shaft, Braking and Suspension systems.
- Acquire the importance of axle and tyre selection
- Understand the Dynamics of the chassis affecting vehicle characteristics

REFERENCES

1. Heinz Heisler, "Advanced Vehicle Technology", Butterworth-Heinemann, Elsevier, Indian Edition, 2011.
2. Heldt P.M., "Automotive Chassis" Chilton Co., New York, 1952
3. Jack Erkavec "A System Approach to Automotive Technology", Cengage Learning India Pvt Ltd., 2009
4. Kripal Singh, "Automobile Engineering (Volume-1)", 12th Edition, Standard Publishers Distributors, 2011.
5. R.K. Rajput, "A Text Book of Automobile Engineering", Laxmi Publications Private Limited, 2007
6. T. Kenneth Garrett, Kenneth Newton and William Steeds, "The Motor Vehicle" 13th Edition, Butterworth-Heinemann Limited**,** London, 2005.

AM5102 AUTOMOTIVE ENGINES AND SUBSYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- 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 – otto, diesel, dual operating cycles – Fuel-Air Cycle - 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 AND IGNITION SYSTEMS 9

Theory of carburetion - Carburetors – Types and their working — Design aspects of Carburetors — Diesel fuel injection - pumps, governors and injectors – Conventional and electronic ignition systems, advance mechanisms – Fuel line hydraulics.

UNIT III COOLING AND LUBRICATING SYSTEMS 9

Air cooling and water cooling – thermosyphon cooling, forced cooling systems. Fins and radiator - design aspects – properties of coolants. Theory of lubrication — types of lubrication, splash lubrication system, petroil lubrication system, forced feed lubrication system - properties of lubricants – Additives used in lubricants.

UNIT IV AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS 9

Importance of swirl, squish and turbulence - Combustion in SI and CI engines. - Premixed combustion, diffused combustion - laminar and turbulent combustion of fuels in engines - Droplet combustion — Cylinder pressure data and heat release analysis. Optimized design of combustion chambers- Supercharger and Turbochargers - VGT

UNIT V ADVANCES IN ENGINE TECHNOLOGY 9

Lean Burn engine – Different approaches to lean bum – LHR engine – Surface ignition concept – catalytic ignition – homogenous charge compression ignition – Stratified charge engines – VCR Engines - variable valve timing – Multi Port Injection System - Gasoline Direct Injection – Common Rail Direct Injection – Recent Trends.

TOTAL : 45 PERIODS

OUTCOMES:

- To students will have the basic knowledge on Automotive Engines and its various sub components along with its functions.

REFERENCES

1. G. S. Springer and A. J. Patterson, 'Engine emissions and pollutant formation', plenum press, New York, 1985.
2. Heinz Heisler, Advanced Engine Technology, SAE publication, 1995.
3. J.B.Heywood, 'Internal combustion engine Fundamentals', McGraw Hill Book Co, 1989.
4. M. L. Mathur, R. P. Sharma, "Internal combustion engines", Dhanpat Rai Publication, 2005
5. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Fourth Edition, 2012.
6. William Crouse, Donald Anglin, "AUTOMOTIVE MECHANICS", Tata McGraw Hill Book Co, 2006

AM5103	AUTOMOTIVE TRANSMISSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I CLUTCH 9

Requirements of Transmission system. Clutches – Functions, Principle of operation and types – single plate, multi plate, diaphragm, centrifugal and overrunning clutches.

UNIT II GEAR BOX 9

Purpose of gear box. Construction and working principle of sliding, constant and synchromesh gear boxes. 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

UNIT III HYDRODYNAMIC TRANSMISSION 9

Fluid coupling – principles - Performance characteristics – advantages – limitations – drag torque – reduction of drag torque. Torque converter - principles - Performance characteristics – advantages – limitations – multi and poly stage torque converters.

UNIT IV AUTOMATIC TRANSMISSION 9

Introduction to epicycle gear trains - Ford – T model gear box, Wilson gear box- Cotal electric transmission. Chevrolet "Turboglide" transmission. – Hydraulic control systems of automatic transmission. Continuously Variable Transmission (CVT) – types – Operations.

UNIT V HYDROSTATIC DRIVE AND ELECTRIC DRIVE 9

Hydrostatic drive – various types of hydrostatic transmission – principle - Advantages and limitations. Comparison of hydrostatic transmission with hydrodynamic transmission. Construction and working principle of Janny hydrostatic drive. Electric drive- Principle of Early and modified Ward Leonard control system – advantages and limitations.

TOTAL : 45 PERIODS

OUTCOMES:

- At the end of the course the students will have command over automotive transmission concepts and applications like the constructional, working principle of various types of manual and automotive transmission of an automobile.
- The performance characteristics, design of clutch and gear box for different vehicle applications.
- The construction and working principles of hydrostatic drive and electric drives used in the automotive transmission system.

REFERENCES

1. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005
2. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002
3. Heldt P.M, Torque Converters, Chilton Book Co., 1992.
4. Jack Erkavec "Automotive Engineering – Automatic Transmission & Transaxles" Classroom and shop Manual, Cengage Learning India Pvt Ltd., 2011
5. Jack Erkavec "Automotive Technology- Manual Transmission", Centage Learning India Pvt Ltd., 2011
6. James Larminie "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England
7. Judge.A.W. Modern Transmission systems, Chapman and Hall Ltd, 2000
8. T. Kenneth Garrett, Kenneth Newton and William Steeds, "The Motor Vehicle" 13th Edition, Butterworth-Heinemann Limited**,** London, 2005.

MA5153 ADVANCED NUMERICAL METHODS L T P C

(Common to Environmental Science and Technology, Chemical Engineering and PRPC) 3 2 0 4

OBJECTIVES :

The course will develop numerical methods aided by technology to solve algebraic, transcendental and differential equations and to apply finite element methods for solving the boundary value problems in differential equations. The course will further develop problem solving skills and understanding of the application of various methods in solving engineering problems. This will also serve as a precursor for future research.

UNIT I ALGEBRAIC EQUATIONS 12+3

Systems of linear equations : Gauss elimination method – Pivoting techniques – Thomas algorithm for tri diagonal system – Jacobi, Gauss Seidel, SOR iteration methods – Conditions for convergence - Systems of nonlinear equations : Fixed point iterations, Newton's method, Eigen value problems : Power method and Given's method.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12+3

Runge - Kutta methods for system of IVPs – Numerical stability of Runge - Kutta method – Adams - Bashforth multistep method, Shooting method, BVP: Finite difference method, Collocation method and orthogonal collocation method.

UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS 12+3

Parabolic equations : Explicit and implicit finite difference methods – Weighted average approximation - Dirichlet's and Neumann conditions – Two dimensional parabolic equations – ADI method : First order hyperbolic equations – Method of numerical integration along characteristics – Wave equation : Explicit scheme – Stability.

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 12+3

Laplace and Poisson's equations in a rectangular region : Five point finite difference schemes, Leibmann's iterative methods, Dirichlet's and Neumann conditions – Laplace equation in polar coordinates : Finite difference schemes – Approximation of derivatives near a curved boundary while using a square mesh.

UNIT V FINITE ELEMENT METHOD 12+3

Basics of finite element method : Weak formulation, Weighted residual method – Shape functions for linear and triangular element – Finite element method for two point boundary value problems, Laplace and Poisson equations.

TOTAL : 60+15 =75 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Solve an algebraic or transcendental equation, linear system of equations and differential equations using an appropriate numerical method.
- Solving the initial boundary value problems and boundary value problems using finite difference and finite element methods.
- Selection of appropriate numerical methods to solve various types of problems in engineering and science in consideration with the minimum number of mathematical operations involved, accuracy requirements and available computational resources.

REFERENCES :

1. Burden, R.L., and Faires, J.D., "Numerical Analysis – Theory and Applications", 9th Edition, Cengage Learning, New Delhi, 2016.
2. Gupta S.K., "Numerical Methods for Engineers", New Age Publishers, 1995.
3. Jain M. K., Iyengar S. R., Kanchi M. B., Jain, "Computational Methods for Partial Differential Equations", New Age Publishers ,1993.
4. Sastry, S.S., "Introductory Methods of Numerical Analysis", 5th Edition, PHI Learning, 2015.
5. Saumyen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.
6. Smith, G. D., "Numerical Solutions of Partial Differential Equations: Finite Difference Methods", Clarendon Press, 1985.

AM5111 ENGINE AND CHASSIS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- 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 and 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. Performance and emission Test of Automotive SI Engine.
2. Performance and emission Test of Automotive CI Engine.
3. Heat balance test on IC engine
4. Performance test on variable compression ratio multi fuel diesel engine.
5. Determination of in-cylinder pressure Vs crank angle.
6. Study of chassis system and Chassis dynamometer.
7. Study of Wheel Alignment System
8. Assembling and dismantling of the following
   i. SI engine.
   ii. CI engine
   iii. V engine
   iv. Single plate, Diaphragm Clutch.
   v. Constant mesh, Sliding mesh gear box
   vi. Transfer case
   vii. Differential
   viii. Front axle, Rear axle
   ix. Brake system
   x. Steering system

TOTAL: 45 PERIODS

AM5201 ENGINE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- 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. 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, mass air 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(four and 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 of operation, 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 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 and closed loop control – Integrated engine control system, Electromagnetic compatibility – EMI Suppression techniques – Electronic dash board instruments – Onboard diagnosis system.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should able to

- Explain the fundamentals, operation, function of various sensors and actuators in engine management systems.
- Explain the fundamentals, operation, function of various fuel injection systems pertain to SI and CI Engine.
- Explain the control algorithm during various engine operating conditions.

REFERENCES

1. Allan Bonnick, “Automotive Computer Controlled Systems”, Butterworth-Heinemann, Elsevier, Indian Edition, 2011.
2. Eric Chowanietz, “Automobile Electronics” by SAE Publications, 1995.
3. Julian Happian, Smith, ‘An Introduction to modern vehicle Design’, Butterworth-Heinemann, 2002.
4. Robert Bosch, “Diesel Engine Management”, SAE Publications 2004.
5. Robert Bosch, “Gasoline Engine Management”, SAE Publications 2004.
6. Steve V. Hatch, “Electronic Engine controls”, Cengage Learning India Pvt Ltd., 2009
7. Tom Denton, “Advanced Automotive Fault Diagnosis”, Butterworth-Heinemann, Elsevier, Indian Edition, 2011.
8. William B. Ribbens, Norman P. Mansour, “Understanding automotive electronics”, Newnes, Elsevier, Indian Edition, 2011.

AM5202	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The main objective of this course is to impart knowledge in automotive pollution 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 8

Sources of Air Pollution. Various emissions from Automobiles — Effects of pollutants on environment and human beings - global warming – Acid Rain - National and International Emission standards.

Automotive waste management - Recycling and End of Life Vehicle (ELV) - Recycling of Metals, Nonmetals, tyres and wiring harness and disposal of hazardous materials.

UNIT II EMISSION FROM SPARK IGNITION ENGINE AND ITS CONTROL 10

Emission formation in SI Engines – Carbon monoxide & Carbon di oxide – Unburned hydrocarbon, NO_X, PM – Effects of design and operating variables on emission formation – controlling of pollutants – fuel modifications - Positive Crank case ventilation system, Evaporative Emission Control, Exhaust Gas Recirculation, Secondary air injection, thermal reactor, Catalytic converters – Types – substrate, Wash coat and Catalyst, Cold start emission control – Close coupled catalytic converter, Hydrocarbon Adsorber- Leam de-NOx Catalysts- NOx traps – Catalyst deactivation.

UNIT III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL 10

Formation of White, Blue, and Black Smokes, Soot, Particulate Matter NOx, SOx, HC, CO and Intermediate Compounds – Significance Effect of design and Operating variables on Emission formation —Fuel modification/additives, CRDI - High Injection Pressure and Injection Rate Shaping and Multiple injection, EGR- EGR Cooling and Heating, EGR Control, Fumigation, Diesel Oxydation Catalysts, Diesel de-NOx Catalysts, NOx traps, SCR, Diesel Particulate Filters - DPF material, structure and regeneration- HCCI Engines.

UNIT IV NOISE POLLUTION FROM AUTOMOBILES 8

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

Test cycles for light and medium duty vehicles – US-EPA cycle, ECE and EUDC cycle, Japanese cycle, Indian driving cycles – steady state and transient cycles - SHED Test - Chassis dynamometer – Constant Volume Sampling (CVS) Procedure for driving cycles - Emission analyzers — NDIR, FID, Chemiluminesecent Analyzer (CLA), Smoke meters, Gas Chromatography, Particulate Emission Measurement - Dilution Tunnel, Sound level meters.

TOTAL : 45 PERIODS

OUTCOMES:

By the end of this course, students will be able to

- Understand the various emissions formed in IC engines
- Understand the effects of pollution on human health and environment
- Understand the emission control techniques
- Understand the emission norms

REFERENCES

1. B.P. Pundir, “Engine Emissions - Pollutant Formation and Advances in Control Technology” Narosa Publishing house Pvt. Ltd, 2011
2. Bernard Challen and Rodica Baranescu, “Diesel Engine Reference Book” – Second edition – SAE International Publications– 1999.
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4. Eran Sher “Handbook of Air Pollution from Internal Combustion Engines- Pollutant Formation and Control” ACADEMIC PRESS, 1998
5. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.
6. Geoff Davies, “Materials for Automobile Bodies”, Butterworth-Heinemann, 2012.
7. Matthew Harrison, “Vehicle refinement: controlling noise and vibration in road vehicles”, Elsevier, Indian Edition, 2011
8. Paul Degobert, “Automobiles and Pollution” SAE Publications, 1991.

AM5203 ELECTRIC AND HYBRID VEHICLES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the methods of representation of system and their transfer function models
- To provide adequate knowledge in the time response of systems and steady state error analysis
- To give basic knowledge in obtaining the open loop and closed loop frequency responses of system
- To understand the concept of stability of control system and methods of stability analysis
- To study the three way of designing compensators for a control system

UNIT I INTRODUCTION 9

Need of electric vehicles hybrid vehicles – comparative study of diesel, petrol, pure electric and hybrid vehicles. Limitations of electric vehicles. Specification of some electric and hybrid vehicles

UNIT II ENERGY SOURCES : BATTERIES AND FUEL CELLS 9

Battery Parameters-Power requirement of electric vehicles- Different types of batteries - Lead acid- Nickel based-Sodium based-Lithium based- Metal Air based. Battery charging-Charger design- Quick charging devices- Battery Modeling. Different type of energy storage – Solar, wind, compressed fluid. Fuel Cell- Fuel cell characteristics- Fuel cell types-Hydrogen fuel cell- Connecting cell in series- water management in the PEM fuel cell-Thermal Management of the PEM fuel cell

UNIT III PROPULSION MOTORS AND CONTROLLERS 12

Characteristic of permanent magnet and separately exited DC motors. AC single phase and 3-phase motor – inverters – DC and AC motor speed controllers.

UNIT IV VEHICLE DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 6

Aerodynamic-Rolling resistance- Transmission efficiency- Vehicle mass- Electric vehicle chassis and Body design considerations- Heating and cooling systems- Controllers- Power steering- Tyre choice- Wing Mirror, Aerials and Luggage racks

UNIT V HYBRID VEHICLES 9

Types of Hybrid- Series, parallel, parallel - Advantages and Disadvantages. Power split device – Energy Management System - Design consideration - Economy of hybrid vehicles

TOTAL : 45 PERIODS

OUTCOMES:

The student should be able to

- Explain how a hybrid vehicle works and describe its main components and their function.
- Describe the different hybrid topologies with respect to their functional blocks and their characteristics.
- Design and implement both simple and advanced models of the vehicles.
- Analyze the performance of a hybrid vehicle.
- Build efficiency models of important components.
- Evaluate the environmental impact of road vehicles.
- Calculate basic electrical and thermal properties for power electronic converters.
- Describe the operating principle and properties for the most common types of electrical motors in hybrid technology.
- Describe the operating principle for fuel cells and energy storage elements and calculate basic performance of them.
- Describe the fuel alternatives for hybrid vehicles.

REFERENCES

1. Amir Khajepour, Saber Fallah and Avesta Goodarzi, “Electric and hybrid Vehicles - technologies, modeling and control: a mechatronic Approach”, Wiley, 2014.
2. Iqbal Husain, “ Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press, 2003
3. Jack Erjavec, “Hybrid, Electric & Fuel-Cell Vehicles”, Delmar, Cengage Learning, 2013.
4. James Larminie and John Lowry, “Electric Vehicle Technology Explained “ John Wiley & Sons, 2003
5. Lino Guzzella, “ Vehicle Propulsion System” Springer Publications,2005
6. Mehrdad Ehsani, “ Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2005
7. Ron HodKinson, “ light Weight Electric/Hybrid Vehicle Design”, Butterworth Heinemann Publication, 2005
8. Sandeep Dhameja, “Electric Vehicle Battery Systems” NEWNES, 2002.

AM5204	VEHICLE DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of this course is to provide fundamental knowledge of the dynamics of ground vehicles, knowledge of suspension design and function, basic concepts on concerning stability and control and to study about basic analysis of vehicle dynamics in performance, handling and ride modes.

UNIT I BASIS OF VIBRATION 9

Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility ratio, Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed. Modal analysis.

UNIT II TYRES 9

Tyre forces and moments, Tyre structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tyre. Performance of tyre on wet surface. Ride property of tyres. Magic formulae tyre model, Estimation of tyre road friction. Test on Various road surfaces. Modes of tyre vibration.

UNIT III VERTICAL DYNAMICS 9

Human response to vibration, Sources of Vibration. State Space Representation. Design, analysis, simulation of Passive, Semi-active and Active suspension using Quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tyre stiffness. Control law for LQR, H-Infinite, Skyhook damping. Air suspension system and their properties.

UNIT IV LONGITUDINAL DYNAMICS AND CONTROL 9

Aerodynamic forces and moments. Equation of motion. Static load distribution for three wheeler and four wheeler. Determination of CG point. Calculation of Maximum acceleration, Reaction forces for Different drives. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control.

UNIT V LATERAL DYNAMICS 9

Steady state handling characteristics. Steady state response to steering input – Yaw velocity gain, Lateral acceleration gain, curvature response gain. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle under side forces. Camber and camber thrust. Stability of vehicle resting on slope, running on banked road, during turn. Effect of suspension on cornering. Minuro Plot for Lateral Transient Response.

Note : students may be given training on Matlab or similar simulation tools.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of this course the student should be able to

- To understand the fundamentals and concepts of vibration
- To analyze the influence of vehicle configuration and design parameters on vehicle performance
- To simulate and analyze vehicle performance
- To grasp the concepts of vehicle handling and stability of vehicles
- Develop physical and mathematical models to predict the dynamic response of vehicles

REFERENCES

1. Dean Karnopp, Vehicle Stability, 1st edition, Marcel Dekker, 2004
2. G. Nakhaie Jazar, Vehicle Dynamics: Theory and Application, 1st edition, Springer, 2008
3. Hans B Pacejka, Tyre and Vehicle Dynamics, 2nd edition, SAE International, 2005
4. J. Y. Wong, Theory of Ground Vehicles, 3rd Edition, Wiley-Interscience, 2001
5. Jan Zuijdijk, Vehicle dynamics and damping, Author House, 2009

6. Michael Blundell & Damian Harty, The Multibody Systems Approach to Vehicle Dynamics, Elsevier Limited, 2004
7. Rajesh Rajamani, Vehicle Dynamics and Control, 1st edition, Springer, 2005
8. Singiresu S. Rao, Mechanical Vibrations (5th Edition), Prentice Hall, 2010

AM5211	AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

1 Testing of
   a. battery
   b. starting systems
   c. charging systems
   d. ignition systems
   e. body controller systems

2 Study of automotive lighting system and adjustment of head lights beam

3 Study of various sensors and actuators used in two wheelers and four wheelers for electronic control

4 Study of Logic gates, Adders, Flip flops

5 Study of SCR and IC Timers

6 Interfacing amplifier, filter, Multiplexer and De-multiplexer

7 Interfacing seven segment displays

8 Basic microprocessor and microcontroller programming like arithmetic and Logic operation, code conversion, waveform generation, look up table

9 Interfacing ADC and DAC for Data Acquisition and Control Application

10 Interfacing Sensors for Measurements of position, displacement, velocity, force, temperature, proximity/range etc

11 Display, Keyboard, Stepper Motor and DC Motor interface using microcontroller.

12 Study of Virtual Instrumentation

13 Study of Development of Embedded Systems

14 Mini Project

TOTAL: 60 PERIODS

AM5301	CHASSIS MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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 to chassis system – construction – working principle of wheel speed sensor, steering position, tyre pressure, brake pressure, steering torque, fuel level, Gyro sensor.

UNIT II DRIVELINE CONTROL SYSTEM 9

Speed control – cylinder cutoff 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 : 45 PERIODS

OUTCOMES:

- At the end of the course, the students will be able to explain working of chassis management systems used in present day vehicles.

REFERENCES

1. Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.
2. Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9th edition, TMH, NewDelhi, 2002.
3. Ljubo Vlacic, Michel Parent, Fumio Harashima, “Intelligent Vehicle Technologies”, Butterworth-Heinemann publications, Oxford, 2001.
4. U. Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer-Verlag, 2000
5. William B.Ribbens -Understanding Automotive Electronics, 5th edition, Butter worth Heinemann Woburn, 1998.

AM5311	COMPUTER AIDED VEHICLE DESIGN LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

Design, model and (Structural / Thermal) analysis of the following components

1. Engine Cylinder
2. Piston Assembly.
3. Connecting rod.
4. Valves.
5. Crank shaft.
6. Cam shaft.
7. Vehicle Frame.
8. Suspension Spring.
9. Front axle.
10. Rear axle.
11. Gear box.

TOTAL: 60 PERIODS

REFERENCES:

1. ACAD, CATIA and ANSYS software guide / manual
2. Dean Averns, "Automobile Chassis Design ", Illiffe Books Ltd, 1992.
3. Dr. N. K. Giri, “Automobile Mechanics”, Seventh reprint, Khanna Publishers,
4. Giles.J.G., Steering, " Suspension and tyres ", Illiffe Books Ltd., London, 1988.
5. Steeds.W., " Mechanics of Road vehicles ", Illiffe Books Ltd., London, 1990.
6. T. Kenneth Garrett, Kenneth Newton and William Steeds, “The Motor Vehicle” 13th Edition, Butterworth-Heinemann Limited**,** London, 2005.

AM5001	ADVANCED THERMODYNAMICS FOR AUTOMOBILE ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The objectives of this course to make the students understand the advanced concepts of thermodynamics applied to I.C. engines. To impart knowledge on entropy and its significance in engine combustion. To provide complete knowledge on chemical kinetics involved in pollution formation.

UNIT I BASIC CONCEPTS **9**

Systems, property, state, path and process- quasi static process, work, modes of work. Review of first and second law of thermodynamics – Application of the energy equation to the engine combustion process. Application to closed and open systems of automobile. internal energy, specific heat capacities, enthalpy, and steady flow process.

UNIT II ENTROPY **9**

Absolute Zero and the Third Law of Thermodynamics. Entropy – Mathematical Definition, Characteristics. Relation between ds, dq and T during an Irreversible Process. Entropy - Change in Internally Reversible Processes. Isentropic Processes. Absolute Entropies. Helmholtz and Gibbs Free Energies, Entropy of Mixing of Ideal Gases.

UNIT III COMBUSTION THERMODYNAMICS 9

Combustion processes. Combustion of simple hydrocarbon fuels, Enthalpy of formation, Bond energies, Chemical Reactions and Combustion. Air – Fuel ratio calculation, Equivalence Ratio, problems.

UNIT IV FLAMES AND CHEMICAL KINETICS 9

Flames – premixed, diffusion, Laminar and turbulent – Explosion limits, Flammability limits, Ignition, Engine combustion systems. Chemical Kinetics – Reaction rates - Rate constant, Pollutants formed through chemical kinetics

UNIT V CHEMICAL EQUILIBRIUM AND DISSOCIATION 9

Chemical equilibrium. Criterion for reaction equilibrium. Equilibrium constant for gaseous mixtures - evaluation of equilibrium composition. The Vant Hoff relationship between equilibrium constant and heat of reaction, Calculation of chemical equilibrium and the law of mass action. Dissociation. Effect of pressure and temperature on dissociation - Problems.

TOTAL : 45 PERIODS

OUTCOMES:

- Students will possess extended knowledge in thermodynamics such as entropy and its significance.
- Students will possess a comprehensive understanding of importance of chemical kinetics and dissociation involved in combustion and pollution formation in IC engines

REFERENCES

1. Bejan, A., Advanced Engineering Thermodynamics, John Wiley and Sons, 1988.
2. Desmond E Winterbone, Advanced Thermodynamics for Engineers. John Wiley & Sons, Inc., 1997.
3. Holman,J.P., Thermodynamics, Fourth Edition, McGraw-Hill Inc., 1988.
4. Kenneth Wark Jr., Advanced Thermodynamics for Engineers, McGraw-Hill Inc., 1995.
5. Sonntag, R.E., and Van Wylen, G, Introduction to Thermodynamics, Classical and Statistical, Third Edition, John Wiley and Sons, 1991

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AM5002 ALTERNATIVE FUELS L T P C

3 0 0 3

OBJECTIVES:

- At the end of the course, the student will be able to acquire knowledge of alternate fuels and the changes in the engine design for handling them.

UNIT I CONVENTIONAL FUELS FOR I.C. ENGINES 9

Petroleum based conventional fuels for SI and CI engine, Demand and Availability of crude oil – vehicle population increase – national and international standards for conventional and alternative fuels.

Desirable characteristics of SI Engine fuels – Petrol – Properties, Specification, chemical structure, Volatility characteristics, knock rating and additives. Desirable characteristics of CI Engine fuels – Diesel – Properties, Specification, chemical structure, Ignition quality, Cetane rating and additives.

UNIT II ALCOHOLS AS FUELS 9

Availability of different alternative fuels for engines. Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of alcohol fuels

UNIT III VEGETABLE OILS AND BIODIESEL AS FUELS 9

Properties of Vegetable oils and biodiesel- Methods of using vegetable oils – Blending, preheating, and emulsification – Preparation of biodiesel from non-edible, edible oil and Algae - Performance, combustion and emission Characteristics in diesel engines. Advantages and disadvantages of Vegetable oils and biodiesel

UNIT IV HYDROGEN AS FUEL 9

Hydrogen – Properties, Production methods, storage and safety aspects. Issues & limitation in Hydrogen. Methods of using hydrogen in engines. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Hydrogen fuel.

UNIT V BIOGAS, CNG AND LPG AS FUELS 9

Biogas, Compressed Natural gas (CNG) and LPG – Properties and production methods. CO_2 and H_2S scrubbing in Biogas, Modifications required for use in Engines- Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Gaseous fuels. Working of LPG and CNG kits used in automotive engines.

TOTAL : 45 PERIODS

OUTCOMES:

By the end of this course, students will be able to

- Student will possess a comprehensive understanding of available alternative fuels for IC engines. They will posses complete knowledge on producing different biofuels, modifying them and using them in IC engines
- Students will acquire the skills in developing new technologies for alternative fuels efficiently in IC engines.
- Students will demonstrate the importance of using alternative fuels for sustainable energy supply and for emission control in IC engines.

REFERENCES

1. Arumugam S. Ramadhas, “Alternative Fuels for Transportation” CRC Press, 2011.
2. Ayhan Demirbas and M. Fatih Demirbas, “Algae Energy-Algae as a New Source of Biodiesel”, Springer-Verlag London Limited 2010.
3. Ayhan Demirbas, ‘Biodiesel A Realistic Fuel Alternative for Diesel Engines’, Springer-Verlag London Limited 2008
4. David M. Mousdale, “Introduction to Biofuels”, CRC Press, 2015.
5. Ganesan.V., “Internal Combustion Engineering”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
6. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
7. M. K. Gajendra Babu and K. A. Subramanian, “Alternative Transportation Fuels-Utilisation in Combustion Engines”, CRC Press, 2013.
8. M.L. Mathur, R.P.Sharma “A course in internal combustion engines”, Dhanpatrai publication, 2003.
9. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.

AM5003	HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I INTRODUCTION 6

Properties - hydraulic fluids and air, Hydraulic fluids, types, factors affecting oil performance, selection, power unit. Selection of pipe / tubing, couplings. Packing and seals, packing standards. Comparison between pneumatic and hydraulic system. Symbols of pneumatic and hydraulic elements.

UNIT II PNEUMATIC SYSTEMS 12

Basic requirement. Elements of pneumatics, constructional details of air compressors, types, specifications, air generation and distribution. 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

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

UNIT IV SERVO AND PLC SYSTEMS 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. Maintenance and trouble shooting. Design and analysis of a hydraulic / Pneumatic system. Case Study

TOTAL : 45 PERIODS

OUTCOMES:

- Students will have the basic knowledge on various laws and simple problem pertaining to hydraulic and pneumatic system. At the end of the course the students will have through knowledge over different component and their function related to hydraulic and pneumatic system and how it is used for automotive applications.

REFERENCES

1. Andrew Parr, “Hydraulic and Pneumatics”, Jaico publishing house, 1999.
2. Anthony Espisito, “ Fluid Power with Application”, Pearson Education (Singapore) Pte.Ltd, Delhi, India, Fifth Edition, First Indian Reprint, 2003
3. Festo KG, “Pneumatic Tips”, Festo, Germany, 1987.
4. Majumdar, S.R., “Oil Hydraulic Systems: Principles and Maintenance”, Tata McGraw- Hill Publishing Company Ltd., New Delhi, Fourth Reprint, 2003.
5. Peter Rohner, “Fluid Power Logic Circuit Design – Analysis, Design Method and Worked Examples”, The Macmillan Press Ltd., UK, 1979.
6. Pippenger, J.J, “Industrial Hydraulic & Pneumatics”, McGraw Hill, 2002.
7. Werner Deppert and Kurt Stoll, “Pneumatic Controls : An introduction to principles“, Vogel-Druck Wurzburg, Germany, 1975.

AM5004	IC ENGINE PROCESS MODELING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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 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 cylinder models. 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 stoichiometric air required for combustion. Conversion of volumetric analysis to mass analysis. Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic 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 air cycle analysis - 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. 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 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.

UNIT V COMPUTER SIMULATION OF CI ENGINE 9

Zero, one and multizone models for diesel engine combustion. Double Wiebe's Law analysis for diesel combustion. Heat release model and different heat transfer models. Equilibrium calculations. Parametric studies on simulated engine performance.

TOTAL : 45 PERIODS

OUTCOMES:

- Student will possess a comprehensive understanding of all the processes involved in engine cycles. They will acquire the skills in developing the complete theoretical model of combustion of an internal combustion engine.
- Students will demonstrate the importance of intake and exhaust processes in developing a theoretical model of a complete engine.
- Students will posses complete knowledge on adiabatic flame temperature, heat transfer and their importance in engine modeling.

REFERENCES

1. Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley & Sons, New York, 1986
2. Benson.R.S., Whitehouse.N.D., "Internal Combustion Engines", Pergamon Press, oxford, 1979
3. Ganesan.V. "Computer Simulation of Compression ignition engine process", Universities Press (I) Ltd, Hyderbad, 2000.
4. Ganesan.V. "Computer Simulation of spark ignition engine process", Universities Press (I) Ltd, Hyderbad, 1996.
5. John. B. Heywood, 'Internal Combustion Engines'", Tata McGraw Hill Co., Newyork, 1988.
6. Ramoss.A.L., "Modelling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992.
7. Lino Guzzella and Christopher H. Onder, "Introduction to Modeling and Control of Internal Combustion Engine Systems" Springer, 2010.

AM5005 PRODUCTION OF AUTOMOBILE COMPONENTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- 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 CASTING **9**

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 and other small auto parts. Melting practice of alloys.

UNIT II MACHINING **9**

Special consideration of machining of various components such as flywheel, piston rings, bearing bushes, and liners. Machining of connecting rods - crank shaft - cam shaft - piston - piston pin – valve - front and rear axle housing - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

UNIT III FORGING, EXTRUSION AND FORMING PROCESS **10**

Forging materials - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, 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 POWDER METALLURGY AND PROCESSING OF PLASTICS **8**

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. Tyre manufacturing, Recycling of tyres

UNIT V RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS 9

Powder injection molding - 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 : 45 PERIODS

OUTCOMES:

By the end of this course, students will be able to

- Understand the methods to manufacture the vehicle components
- Understand the requirements of each component and material
- Understand the step by step procedure for manufacturing vehicle components
- Understand the advanced techniques used for manufacturing Automobile components

REFERENCES

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

AM5006	THEORY OF FUELS AND LUBRICANTS	L	T	P	C
		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, transesterification products of refining process. Additive - mechanism, requirements of additive, petrol fuel additives, diesel fuel additives - Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants. Additives and additive mechanism, for lubricants. Introduction to Nano fluids

UNIT II THEORY OF LUBRICATION 9

Engine friction: introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication 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, testing.

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 corrosion etc.

UNIT V FUELS AND COMBUSTION 9

Stoichiometry – calculation of theoretically correct air required for combustion of liquid and gaseous fuels – reaction equation, properties of air/fuel mixture, Heat of reaction, complete combustion in C/H/O/N Systems, Constant volume adiabatic combustion, constant pressure adiabatic combustion, Calculation of adiabatic flame temperature, combustion chart.

TOTAL : 45 PERIODS

OUTCOMES:

- At the end of the course, the students will be able to have a complete knowledge on the various properties of fuels, lubricants and testing methods.

REFERENCES

1. A.R.Lansdown – Lubrication – A practical guide to lubricant selection – Pergamon press – 1982
2. Brame, J.S.S. and King, J.G. – Fuels – Solids, Liquids, Gaseous.
3. Francis, W – Fuels and Fuel Technology, Vol. I & II
4. Ganesan.V., “Internal Combustion Engineering”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
5. Hobson, G.D. & Pohl.W- Modern Petroleum Technology
6. M.L. Mathur, R.P.Sharma “A course in internal combustion engines”, Dhanpatrai publication, 2003.
7. Obert.E.F “Internal Combustion Engineering and Air Pollution”, International book Co., 1988.
8. Raymond.C.Gunther – Lubrication – Chilton Book Co., - 1971.

AM5007 VEHICLE DESIGN AND DATA CHARACTERISTICS L T P C
3 0 0 3

OBJECTIVES:

- Students have to collect important technical specifications of an automobile from Automobile Journals and keeping this, as a guide, they have to calculate and tabulate various vehicle performance parameters and design parameters and to draw curves using these data.

UNIT I INTRODUCTION 9

Assumptions to be made in designing a vehicle, Range of values for Gross Vehicle Weight, Frontal Area, maximum speed, maximum acceleration, gradability in different gears, Basics of Automobile Design.

UNIT II RESISTANCE TO VEHICLE MOTION 9

Calculation, Tabulation and Plotting of Curves for Air and Rolling Resistances at various vehicle speeds, Calculation and Plotting of Driving force, Power requirement for different loads and acceleration, Maximum Power calculation

UNIT III PERFORMANCE CURVES-I 9

Calculation, Tabulation and Plotting of Torque and Mechanical Efficiency for different vehicle speeds, Interpolation of Pressure – Volume diagram, Calculation of frictional Mean Effective Pressure, Calculation of Engine Cubic Capacity, Bore and Stroke Length

UNIT IV PERFORMANCE CURVES – II 9

Connecting rod length to Crank Radius Ratio, Plotting of Piston Velocity and Acceleration against Crank Angle, Plotting Gas force, inertia force and Resultant force against Crank Angle, Turning Moment and Side Thrust against Crank Angle.

UNIT V GEAR RATIOS 9

Determination of Gear Ratios, Acceleration and Gradability, Typical Problems on Vehicle performance

TOTAL : 45 PERIODS

OUTCOMES:

- The students can able to understand the basic design principle of vehicle, able to draw the performance curves pertain to engine and chassis.

REFERENCES

1 Giri. N. K., "Automotive Mechanics", Khanna Publishers, New Delhi, 2005.
2 Gupta. R.B., "Automobile Engineering", Sathya Prakashan, 8 edition., 2013.
3 Heldt, P.M., "High Speed Combustion Engines", Oxford and I.B.H. Publishing Co., Kolkata, 2002.

EY5151 FLUID MECHANICS AND HEAT TRANSFER L T P C
3 0 0 3

OBJECTIVES:

- To understand the laws of fluid flow and Heat transfer
- To develop the skills to correlate the Physics with applications

UNIT I BASIC EQUATION, POTENTIAL FLOW THEORY AND BOUNDARY LAYER CONCEPT 9

Three dimensional continuity equation – differential and integral forms – equations of mass, momentum and Energy and their engineering applications. Rotational and irrotational flows – circulation – vorticity – stream and potential functions. Boundary Layer - displacement and momentum thickness – laminar and turbulent boundary layers in flat plates – circular pipes.

UNIT II INCOMPRESSIBLE AND COMPRESSIBLE FLOWS 9

Laminar and turbulent flow between parallel plates – flow through circular pipe – friction factor – smooth and rough pipes – Moody diagram – losses during flow through pipes. Pipes in series and parallel – transmission of power through pipes. One dimensional compressible fluid flow – flow through variable area passage – nozzles and diffusers.

UNIT III CONDUCTION AND RADIATION HEAT TRANSFER 9

Governing Equation and Boundary conditions, Extended surface Heat Transfer, Transient conduction – Use of Heisler's charts, Conduction with moving boundaries, Radiation - Heat Transfer, Gas Radiation

UNIT IV TURBULENT FORCED CONVECTIVE HEAT TRANSFER 9

Turbulence theory – mixing length concept – turbulence model – k Є model – analogy between heat and momentum transfer – Reynolds, Colburn, Prandtl turbulent flow in a tube – high speed flows.

UNIT V PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER 9

Condensation on bank of tubes – boiling – pool and flow boiling, Heat exchanger – Є – NTU approach and design procedure – compact heat exchanger.

TOTAL: 45 PERIODS

OUTCOME

- Student will be able to use the concepts of Heat Transfer and fluid flow in the field of energy applications.

TEXT BOOKS

1. Anderson, J.D., Fundamentals of Aerodynamics, McGraw Hill, Boston, 2001.
2. Bansal,R.K., Fluid Mechanics, Saurabh and Co., New Delhi, 1985.
3. Ghoshdastidar.P.S., Heat Transfer, Oxford University Press, 2004
4. Holman.J.P., Heat Transfer, Tata McGraw Hill, 2002.
5. Ozisik. M.N., Heat Transfer – A Basic Approach, McGraw Hill Co., 1985.
6. Streeter, V.L., Wylie, E.B., and Bedford, K.W., Fluid Mechanics, WCB McGraw Hill, Boston, 1998.

AM5008 AUTOMOTIVE AIR CONDITIONING SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

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 9

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 Systems - 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

Block diagram - 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 DESIGN 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 : 45 PERIODS

OUTCOMES:

To students will have the basic knowledge on psychometric terminologies and simple problem pertaining to psychometric and refrigerant system. At the end of the course the students will have through knowledge over different component and their function related to different type of vehicle air conditioning system.

REFERENCES

1. Boyce H. Dwiggins, Jack Erjavec., “Automotive Heating and Air-Conditioning”, Delmer publisher., 2001.
2. Goings. L.F., “Automotive air conditioning”, American Technical services, 1974
3. James D. Halderman, “Automotive Heating, Ventilation, and Air Conditioning Systems”, Pearson Education Inc., 2004.
4. MacDonald, K.L., “Automotive air conditioning”, Theodore Audel series, 1978.
5. Paul Weiser, “Automotive air conditioning”, Reston Publishing Co Inc., 1990
6. SAE paper No: 931121,900084, 850040,931137,870029 etc.
7. Tom Birch, “Automotive Heating and Air Conditioning” Pearson Education Inc., 2003.
8. Vehicle service manuals.
9. William H Crouse and Donald L Anglin, “Automotive air conditioning”, McGraw - Hill Inc., 1990

AM5009	COMBUSTION THERMODYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVES:

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. 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

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

UNIT III FLAMES 9

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

UNIT IV HEAT TRANSFER IN IC ENGINES 8

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

UNIT V INSTRUMENTATION 8

Pressure sensors, crank angle encoder. Hot wire and laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines. In-cylinder pressure measurement and Rate of heat release calculation.

TOTAL : 45 PERIODS

OUTCOMES:

- Student will possess a comprehensive understanding of thermodynamics involved in combustion process of I.C. Engines.
- Students will demonstrate the importance of engine heat transfer in designing modern engine combustion systems.
- Students will posses complete knowledge in engine pressure data acquisition and analysis for combustion parameters.

REFERENCES

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

AM5010	VEHICLE BODY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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 8

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car – Visibility- regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car body construction-Various panels in car bodies. Safety aspect of car body.

UNIT II BUS BODY 9

Types of bus body: based on capacity, distance traveled and based on construction.– Layout for various types of Bus body, Types of metal sections used – Regulations – Constructional details: Conventional and integral. Driver seat design - Safety aspect of bus body.

UNIT III COMMERCIAL VEHICLE BODY 9

Types of commercial vehicle bodies – LCV, MCV, HCV. Construction details of - Flat platform body, Trailer, Tipper and Tanker body – Dimensions of driver's seat in relation to controls – Drivers cab design.

UNIT IV VEHICLE AERODYNAMICS 10

Vehicle drag and types. Types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation, Types. Wind tunnel testing such as: Flow visualization techniques, Airflow management test – measurement of various forces and moments by using wind tunnel. Drag reducing devices.

UNIT V BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR 9

Types of materials used in body construction-Steel sheet, timber, plastics, GRP, properties of materials. Body trim items-body mechanisms. Hand tools - power tools -panel repair-repairing sheet metal-repairing plastics-body fillers-passenger compartment service-corrosion: Anticorrosion methods, Modern painting process procedure-paint problems

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, students will

- Know about different aspects of car body and bus body, types, commercial vehicle.
- Role of various aerodynamic forces and moments, measuring instruments.
- Know about the material used in body building, tools used, body repairs.

REFERENCES

1. Braithwaite, J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London, 1997
2. Dieler Anselm., The passenger car body, SAE International, 2000
3. Geoff Davies, "Materials for Automobile Bodies", Butterworth-Heinemann, 2012.

4. Giles, G.J., Body construction and design, Illiffe Books Butterworth & Co., 1991
5. James E Duffy, Body Repair Technology for 4-Wheelers,Cengage Learning,2009.
6. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd., London, 1992.
7. Powloski, J., Vehicle Body Engineering, Business Books Ltd., 1998.

AM5011	FINITE ELEMENT METHODS IN AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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

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, heat transfer and fluid flow problems. Advantages and limitations of FEM. Test for convergence. Element choice. Commercial finite element packages. Solution of Boundary value problem - Integral formulation 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 by direct and polynomial methods. Boundary condition and assemblage concepts. Beam element characteristics matrix. Global, local, natural coordinates.

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. Treatment of boundary condition. 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 vibration problem formulation. Torsion of non circular shaft - axisymmetric problem. Case Studies like Structural 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. Transient thermal analysis. Case Studies like Heat transfer analysis of piston, fins.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completing this course, the students will be able to:

- Identify mathematical model for solution of common engineering problems.
- Formulate simple problems into finite elements.
- Solve structural, thermal, fluid flow problems.
- Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
- Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts

REFERENCES

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

AM5012	SIMULATION OF VEHICLE SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the role of modeling and simulation in vehicle design
- To learn about system parameters and states for an automotive vehicle
- To learn about the simulation and analysis of the various vehicle systems

UNIT I INTRODUCTION 9

Introduction to Modeling and simulation, Role of modeling and simulation, Modeling and simulation process, Discrete event dynamic systems, Continuous time dynamic systems

UNIT II MODELING & SIMULATION OF DRIVETRAIN SYSTEM 9

Basic driveline model, Modeling of neutral gear, Driveline control – Goals, state space formulation, controller formulation, Driveline control for Speed, Driveline control for gear shifting, Modeling and simulation of power train of a passenger car

UNIT III MODELING & SIMULATION OF SUSPENSION SYSTEM 9

Passive suspension - 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, Semi-active suspension - Optimal Semi-Active Control Law, Calculation of Transfer Function Plots - Performance of Semi-Active Suspension Systems, Active Automotive Suspensions

UNIT IV MODELING & SIMULATION OF BRAKING SYSTEMS 9

Friction models, Lumped parameter models – drum brake and disc brake, Modal approach for brake disk vibrations, Electronic stability program – Brake slip controller, Traction slip controller, Electronic brake force distribution, Brake assist

UNIT V MODELING AND SIMULATION OF COMPLETE VEHICLE 9

Wheel model – wheel ground contact point velocities, tire side slip angle, friction co-efficient, Chassis translatory motion, Chassis rotational motion, suspension model, vehicle stability analysis, validation of vehicle model

TOTAL : 45 PERIODS

OUTCOMES:

- The student can learn about the importance of modeling and simulation in vehicle design process
- The student can derive the fundamental equations for various vehicle systems with relevant system parameters
- The student can analyze a vehicle system and identify for sensitive parameters

REFERENCES

1. Dieter Schramm, Manfred Hiller, Roberto Bardini –" Vehicle Dynamics Modeling and Simulation", Springer-Verlag Berlin Heidelberg, 2014
2. Giampiero mastinu, Manfred Ploechl – "Road and off road Vehicle System dynamics handbook", CRC press, Boca Raton, USA, 2014
3. Louis G. Birta, Gilbert Arbez- "Modelling and Simulation Exploring Dynamic System Behaviour", Springer, London, 2013
4. Rajesh Rajamani, "Vehicle Dynamics and Control", Springer, 2006
5. Uwe Kiencke, Lars Nielsen – "Automotive Control Systems For Engine, Driveline, and Vehicle", Springer-Verlag, Berlin Heidelberg, 2005

AM5013 TWO AND THREE WHEELERS L T P C
3 0 0 3

OBJECTIVES:

- 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 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 systems.

UNIT III CLUTCHES AND TRANSMISSION 10

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

UNIT IV FRAMES, SUSPENSION, WHEELS AND TYRES 8

Types of frames. 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, wheel types, wheel mountings attachment, tyre types. Brake systems.

TOTAL : 45 PERIODS

OUTCOMES:

- To students will have the basic knowledge on various two wheelers and its technology along with its functions. At the end of the course the students will have through knowledge over different frames, suspension system and transmission unit used on various two and three wheeler vehicles

REFERENCES

1. 'Cycle Motor Manual', Templeton Press Ltd., London, 1992.
2. Irving P.E., "Motor Cycle Engineering", Temple Press Book, London, 1964
3. Johns.B.A., 'Motorcycles', Good Heartwill, 1984.
4. M.M.Griffin., 'Motor cycles from inside and outside', Prentice Hall Inc, New Jersey, 1978.
5. Marshal Cavandedish, 'Encyclopedia of Motor cycling', New York, 1989
6. Servicing Manuals- various motor cycles, Scooters, Mopeds and three wheelers.
7. Srinivasan.S., 'Motor cycle, Scooter, Mopeds', New century book house, 1988.

TE5071 COMPUTATIONAL FLUID DYNAMICS FOR THERMAL SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- This course aims to introduce numerical modeling and its role in the field of heat, fluid flow and combustion it will enable the students to understand the various discretisation methods and solving methodologies and to create confidence to solve complex problems in the field of heat transfer and fluid dynamics.
- To develop finite volume discretised forms of the CFD equations.
- To formulate explicit & implicit algorithms for solving the Euler Equations & Navier Stokes Equations.

UNIT I GOVERNING DIFFERENTIAL EQUATIONS AND DISCRETISATION TECHNIQUES 8

Basics of Heat Transfer, Fluid flow – Mathematical description of fluid flow and heat transfer – Conservation of mass, momentum, energy and chemical species - Classification of partial differential equations – Initial and Boundary Conditions – Discretisation techniques using finite difference methods – Taylor's Series - Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II DIFFUSION PROCESSES: FINITE VOLUME METHOD 10

Steady one-dimensional diffusion, Two and three dimensional steady state diffusion problems, Discretisation of unsteady diffusion problems – Explicit, Implicit and Crank-Nicholson's schemes, Stability of schemes.

UNIT III CONVECTION – DIFFUSION PROCESSES: FINITE VOLUME METHOD 9

One dimensional convection – diffusion problem, Central difference scheme, upwind scheme – Hybrid and power law discretization techniques – QUICK scheme.

UNIT IV FLOW PROCESSES: FINITE VOLUME METHOD 9

Discretisation of incompressible flow equations – Pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms

UNIT V TURBULENCE AND ITS MODELING 9

Description of turbulent flow, free turbulent flows, flat plate boundary layer and pipe flow. Algebraic Models, One equation model, k – ε & k – ω models Standard and High and Low Reynolds number models.

TOTAL: 45 PERIODS

OUTCOME:

- On successful completion of this course the student will be able to apply concept of CFD to analyse flow in thermal systems.

REFERENCES

1. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and Heat Transfer " Hemisphere Publishing Corporation, New York, USA, 2012.
2. Bose, T.K., "Numerical Fluid Dynamics" Narosa Publishing House, 1997.
3. Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics 1" Fundamental and General Techniques, Springer – Verlag, 1991.
4. Fletcher, C.A.J. "Computational Techniques for fluid Dynamics 2" Specific Techniques for Different Flow Categories, Springer – Verlag, 1988.
5. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2003.
6. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2003.
7. Subas and V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.
8. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier-Stokes Equation", Pineridge Press Limited, U.K., 1981.
9. Versteeg and Malalasekera, N, "An Introduction to computational Fluid Dynamics The Finite volume Method," Pearson Education, Ltd., 2007.

AM5014	AUTOMOTIVE ELECTRICAL TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

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.

UNIT I TYPES OF BATTERIES 9

Battery design, Classification of batteries, Principle and construction of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal-Hydride, Hybrid Battery, Sodium Sulphur Battery and Aluminum Air Battery, Alkaline batteries, Lithium batteries, Characteristics of Batteries, Battery Rating, Capacity and Efficiency, Tests on Batteries, Battery–Charging Techniques, Battery care and maintenance.

UNIT II ELECTRICAL COMPONENTS 9

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Overrunning clutches, Starter-motor controls. Generators and Alternators, Power requirements of the loads in the vehicle, Design factors, types, construction, principle of operation and Characteristics, Voltage and Current Regulation, Cut –out relays and regulators, Charging circuits for D.C. Generator, A.C. Single Phase and Three – Phase Alternators. Over voltage protection, Cooling and noise, Charging system components.

UNIT III IGNITION SYSTEMS 9

Battery Coil and Magneto–Ignition System, Circuit details and Components of Battery Coil and Magneto–Ignition System, Centrifugal and Vacuum Advance Mechanisms, Spark plugs: Function, Requirements, Design, Constructional details and types, Electrode materials, Spark-plug concepts, Electrode gap, Spark position, Spark-plug heat ranges.

UNIT IV ELECTRONIC IGNITION SYSYTEMS 9

Electronically–Assisted and Full Electronic Ignition System, Non–Contact–type Ignition Triggering devices, Capacitive Discharge Ignition Distributor–less Ignition System, Digital Ignition System, Control Strategy of Electronic Ignition System.

UNIT V WIRING, LIGHTING AND OTHER INSTRUMENTS 9

Electrical and electronic symbols, Automotive Wiring circuits, Circuit protection, Insulated and Earth Return System, Positive and Negative Earth Systems.

External lightings: Fog lights, Tail lights, Turn signals, Daytime running lights, Headlights, Lighting circuits, Anti–Dazzling and Dipper Details, Regulations relating to external lights.

Theory and Constructional Details of Dash Board Instruments and their Sensors like Speedometer, Odometer, Fuel Level Indicator, Oil Pressure and Coolant Temperature Indicators and other warning lamps.

Auxiliaries – Circuits and working principles of Wiper motors, Headlight wipers and washers, Horns, Cooling fan motors, Electrical and Electronic Fuel Lift Pumps.

TOTAL : 45 PERIODS

OUTCOMES:

Students will have the basic knowledge on various electrical components and systems used in automobiles. At the end of the course the students will have through knowledge over different batteries, starter motors, alternators, ignition system and lighting systems used on various vehicles.

REFERENCES:

1. "Alternators and Starter Motors", Published by Robert Bosch GmbH, 2003.
2. "Ignition Systems for Gasoline Engines", Published by Robert Bosch GmbH, 2003.
3. "Motor-Vehicle Batteries and Electrical Systems", Published by Robert Bosch GmbH, 2003.
4. Al Santini, "Automotive Technology- Electricity and Electronics", Cengage Learning India Pvt Ltd., 2011
5. Crouse. W. H. Automobile Electrical Equipment, McGraw Hill Book Co Inc.NewYork,2005
6. Judge. A. W. Modern Electrical Equipments of Automobiles, Chapman & Hall, London 2004.
7. Kholi .P.L. Automotive Electrical Equipment, Tata McGraw-Hill Education Pvt. Ltd., 2004
8. Robert Bosch, Automotive Handbook, Bently Publishers,2004

AM5015	AUTOMOTIVE AERODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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 – Fuel consumption and performance – Significance 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

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UNIT III SHAPE OPTIMIZATION OF CABS 7

Front end 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

Crashworthiness, Crash design techniques for front structures, Lumped Mass Spring (LMS) models, Analytical design tools, Collapse modes

UNIT V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 10

Principles of wind tunnel technology – Types, Stress with scale models – full scale wind tunnels – measurement techniques – Equipment and transducers – road testing methods. Introduction to CFD.

TOTAL : 45 PERIODS

OUTCOMES:

On completion of the course the student will have

- an ability to apply concepts of fluid dynamics on vehicle motion
- an ability to interpret the influence of vehicle design on fuel economy
- an exposure on drag reduction enhancing vehicle performance
- an ability to develop programs and interpret test data through computational fluid dynamics

REFERENCES

1. Automotive Aerodynamics: Update SP-706, SAE, 1987.
2. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 4th Edition, SAE 1998.
3. Pope, A, Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1994.
4. Vehicle Aerodynamics, SP-1145, SAE, 1996.

AM5016	AUTOMOTIVE SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the various safety equipments and systems in automotive safety
- To learn about the energy based approach employed in automotive crash modelling and analysis
- To know about the bio-mechanics modelling and simulation tests for automotive collision

UNIT I INTRODUCTION 9

Evolution of automotive safety, Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, concept of crumble zone, safety sandwich construction

UNIT II SAFETY EQUIPMENTS & SYSTEMS 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, Collision warning system, Central Locking system, Child safety

UNIT III SAFETY CONCEPTS 9

Design of the body for safety, Conservation of momentum, Conservation of energy - Energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle

UNIT IV CRASH MECHANICS 9

Crashworthiness, Crash design techniques for front structures, Lumped Mass Spring (LMS) models, Analytical design tools, Collapse modes

UNIT V CRASH TEST & MODELLING 9

Human body modelling, Bio mechanics and occupant simulation, Pedestrian protection and safety, Vehicle simulation tests – frontal, lateral, rear end collisions and roll over. Accident reconstruction,

TOTAL : 45 PERIODS

OUTCOMES:

- The student can learn about the working of important safety components and systems in an automobile
- The student can derive the energy equation for crash analysis for various crash conditions
- The student can learn about the modelling of crash event and the response of human body to crash

REFERENCES

1. George A. Peters & Barabara J. Peters – "Automotive Vehicle Safety", 2002, Taylor & Francis, London, 2002
2. Mathew Huang – "Crash Mechanics", CRC Press LLC, New York, 2002
3. Priya Prasad, Jamel E. Belwafa – "Vehicle Crashworthiness and Occupant Protection", American Iron and Steel Institute, Michigan, 2004
4. Robert Bosch GmbH- "Safety, comfort and convenience systems", Robert Bosch GmbH, England, 2006
5. Ulrich Seiffert and Lothar Wech, "Automotive Safety Handbook", SAE International, Warrendale, 2007

AM5017	INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I MEASUREMENT SYSTEMS 8

Static and Dynamic Measurement systems-importance of measurement system – methods of measurement -applications - characteristics of measuring system-static and dynamic characteristics of measuring system – Analysis of experimental detail, Error analysis-types of errors-limiting errors

UNIT II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES 8

Transducers for Automotive Applications – Amplifiers-Classifications and application in automobile – filters -types – Data Acquisition system - analog and digital type DAS-Indicators, Printers and display device –Signal Analyzing with example of automobile applications.

UNIT III MECHANICAL MEASUREMENT 10

Instrumentation for Measuring Weight, Force, torque , pressure, power, temperature, fluid flow and special methods , vibration piezo electric effect, rotational speed .Measuring Velocity, acceleration and angular motion with respect to automobile applications

UNIT IV ENGINE EXPERIMENTAL TECHNIQUES 10

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- Dynamic cornering fatigue, 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 criteria and 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

OUTCOMES:

At the end of this course the student will be able to

- Understand the components of the automotive instruments and their functions and the latest developments in this field
- Understand transducers, modifiers and terminating devices
- Understand mechanical measurement
- Grasp the basics of engine experimental techniques
- Grasp the basics of vehicle experimental techniques

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. J.G. Giles, 'Engine and Vehicle Testing', Illiffe books Ltd., London,1968.
4. Rangan, Sharma and Mani, 'Instrumentation Devices and systems', Tata McGraw Hill Publishing Co., Ltd., 1990
5. T.G. Beckwith and Buck, 'Mechanical Measurements', Oxford and IBH Publishing House, New Delhi, 1995

AM5018 SPECIAL TYPE OF VEHICLES

L	T	P	C
3	0	0	3

OBJECTIVES:

- 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 details, capacity and applications of earthmovers for dumpers, front-end loaders, bulldozers, excavators, backhoe loaders, scrappers, motor graders etc. criteria for selection of prime mover for 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 AND 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 of dumper body, loader bucket and water tank of sprinkler. Articulated vehicles, double decker. Fire fighting 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 : 45 PERIODS

OUTCOMES:

At the end of this course the student will

- Know the concept and principle of operation of special vehicles such as bull dozers ditchers bucket excavators far equipments military vehicles etc
- Have better understanding of the application of the special types of vehicles in the excavation.
- Understand earth moving and constructional equipments
- Learn the basics of power train concepts for special vehicles
- Grasp the maintenance of farm equipments, military and combat vehicles

REFERENCES

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

AM5019	VEHICLE MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- At the end of the course, the students will be able 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 10

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

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY 8

Body panel tools for repairing. Tinkering and painting. Use of soldering, metalloid paste. Tyre maintenance, metallic, plastics

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 : 45 PERIODS

OUTCOMES:

- At the end of the course, the students will be able to have a complete knowledge of the vehicle maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail.

REFERENCES

1. A,W.Judge, Maintenance of high speed diesel engines, Chapman Hall Ltd., London, 1956.
2. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London , 1969.
3. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay, 1963
4. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay, 1963
5. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953.
6. John Dolce, Fleet maintenance, Mcgraw Hill, Newyork, 1984

7. S. Abbey, Automotive Transmission servicing and overhaul, Sir Issac Pitman, London, 1971.
8. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.
9. V.L.Maleev, Diesel Engine operation and maintenance, McGraw Hill Book CO., Newyork, 1995.
10. Vehicle servicing manuals.
11. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi, 1986.

AM5020	TRANSPORT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:
The students are able to manage a transport fleet and their related activities for minimizing Operational cost.

UNIT I INTRODUCTION 9
Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests

UNIT II TRANSPORT SYSTEMS 9
Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

UNIT III SCHEDULING AND FARE STRUCTURE 9
Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

UNIT IV MOTOR VEHICLE ACT 9
Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

UNIT V MAINTENANCE 9
Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, students will
- Know about different aspects related to transport system and management.
- Features of scheduling, fixing the fares
- Know about the motor vehicle act and maintenance aspects of transport.

REFERENCES

1. Government Motor Vehicle Act, Publication on latest act to be used as on date
2. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
3. Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992

MF5072 RESEARCH METHODOLOGY L T P C
3 0 0 3

OBJECTIVES

- To impart scientific, statistical and analytical knowledge for carrying out research work effectively.

UNIT I INTRODUCTION TO RESEARCH 9

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques – Need for theoretical frame work – Hypothesis development – Hypothesis testing with quantitative data. Research design – Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

UNIT II EXPERIMENTAL DESIGN 9

Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales – Validity testing of scales – Reliability concept in scales being developed – Stability Measures.

UNIT III DATA COLLECTION METHODS 9

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design – Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques – Probabilistic and non-probabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size.

UNIT IV MULTIVARIATE STATISTICAL TECHNIQUES 9

Data Analysis – Factor Analysis – Culster Analysis -Discriminant Analysis – Multiple Regression and Correlation – Canonical Correlation – Application of Statistical(SPSS) Software Package in Research.

UNIT V RESEARCH REPORT 9

Purpose of the written report – Concept of audience – Basics of written reports. Integral parts of a report – Title of a report, Table of contents, Abstract, Synopsis, Introduction, Body of a report – Experimental, Results and Discussion – Recommendations and Implementation section – Conclusions and Scope for future work.

TOTAL = 45 PERIODS

OUTCOME

- After completion of the syllabus students will able to get knowledge about the different research techniques and research report.

REFERENCES
1. C.R.Kothari, Research Methodology, WishvaPrakashan, New Delhi, 2001.
2. Donald H.McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002.
3. Donald R. Cooper and Ramela S. Schindler, Business Research Methods, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2000
4. G.W.Ticehurst and A.J.Veal, Business Research Methods, Longman, 1999.
5. Ranjit Kumar, Research Methodology, Sage Publications, London, New Delhi, 1999.
6. Raymond-Alain Thie'tart, *et.al.,* Doing Management Research, Sage Publications, London, 1999
7. Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.

AM5021	AUTOMOTIVE TESTING AND CERTIFICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:
To illustrate the Automotive Testing and Certification of passenger cars.

UNIT I INTRODUCTION AND ENGINE TESTING 9
Need of vehicle testing and homologation, Vehicle testing organizations, Hierarchy of testing: Individual component approval, System level approval and Whole vehicle approval. Classification of vehicles (including M, N and O layout), regulations overview (ECE, EEC, FMVSS, AIS, CMVR, ADR), Laboratory testing of basic engine parameters: Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers, hydraulic, eddy current etc., engine analyzers- for petrol and diesel engines, FIP calibrating and testing.

UNIT II VEHICLE TESTING : PART 1 9
Vehicle testing on chassis dynamometers: Two wheel & four wheel dynamometers, vehicle testing lanes - side slip testers. CMVR physical verification, Vehicle weighment, Coast down test, Brake test, ABS, Turning circle diameter test, Steering effort test, Wheel Alignment testing, Wheel Balancing, Speedometer calibration, Pass by noise test, External projection test, Wheel guards, Hood latch test, Tell tale symbols, Gradeability test, Accelerator control system.

UNIT III VEHICLE TESTING : PART 2 9
Horn installation, Rear view mirror installation, Installation requirements for lighting & signaling devices, Windscreen Wiping system. Vertical orientation for dipped beam - head lamp, Interior Fittings, Driver's field of vision (M1 category), Steering Impact test (GVW < 1500 kg) , Body block test, Head form test, Crash test, side impact test, rollover test, Bumper Testing, Vehicle - mass emission, Evaporative emission *(petrol vehicles only),* Broad band / Narrow band EMI test, Safety belt assemblies, Crash test with Dummy, Fire resistance test, OBD I.

UNIT IV VEHICLE COMPONENT RELATED TEST PART 1(M1 CATEGORY) 9
Size and Ply rating of tyres, Safety Glasses: 1. Windscreen laminated safety glass 2. Side window / door glass 3. Back light / rear toughened glass; Windscreen wiping system, Wiper Blade, Reflector, Horn, Automotive lamps, Hydraulic brake hose, Hydraulic brake fluid, Wheel rims, Rear View Mirror Specifications(Exterior), Rear View Mirror Specifications(Interior), Wheel nuts, wheel discs & hub caps, Door locks & door retention

UNIT V VEHICLE COMPONENT RELATED TEST PART 2 (M1 CATEGORY) 9

Performance requirements for Lighting & Signaling devices, Head lamp assembly (Glass lense), Head lamp assembly (Plastic lens), Head lamp + Front Position lamp / Front Direction Indicator lamp / Front Fog lamp, Rear combination lamp (each additional function), Independent Front Position lamp / Front Direction Indicator lamp / Front Fog lamp, Rear combination lamp (single function), Fuel tank : Metallic, Plastic (*excluding fire resistance test*), Bumper (F&R), Warning Triangles, Safety belt assemblies, Safety belt anchorages, Seat anchorages and head restraints.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course the student will be familiar in the various testing procedures for passenger car for its approval and testing of individual components.

REFERENCES:

1. Automotive Industry Standard (AIS) and Motor Vehicle Manuals
2. B.P. Pundir, “Engine Emissions - Pollutant Formation and Advances in Control Technology” Narosa Publishing house Pvt. Ltd, 2011
3. Eran Sher “Handbook of Air Pollution from Internal Combustion Engines- Pollutant Formation and Control” Academic Press, 1998
4. Federal Motor Vehicle Safety Standards (FMVSS) available in webpage https://en.wikipedia.org/wiki/Federal_Motor_Vehicle_Safety_Standards
5. Paul Degobert, “Automobiles and Pollution” SAE Publications, 1991.
6. Robert Bosch, Automotive Handbook, Bently Publishers,2004
7. The Central Motor Vehicles Rules, 1989 available in webpage http://www.tn.gov.in/sta/Cmvr1989.pdf