M.E Automobile Engineering

Curriculum and Syllabus

Regulations 2021

(Based on Choice Based Credit System (CBCS))

Effective from the Academic year

2021-2022

Department of Automobile Engineering

School of Engineering

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES

School of Engineering
Department of Automobile Engineering

VISION OF THE DEPARTMENT

To impart excellent education in Automobile Engineering to develop competent and reliable engineers for industry requirement who will also carry out research on continuous basis for the betterment of society.

MISSION OF THE DEPARTMENT

1: To offer superlative learning experience through innovative teaching practices supported with excellent laboratory facilities and exposure to recent trends in the automotive industry.

2: To develop comprehensive knowledge in automobile engineering with equal emphasis on theoretical and practical aspects and problem-solving skills.

3: To identify and develop industry attached laboratories so that students will become familiar with emerging industrial practices.

4: To focus on Industry-Institute Interaction for improved understanding of the latest technologies, training, internship, research promotion and entrepreneurship.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO-1: Independently create and blend knowledge, presentmethodological reports by the way of professional and ethical practices.

PEO-2: Employ recent engineering tools and critical thinking in solving engineering problems and widen solutions through novelty and creativity.

PEO-3: Exhibit valuable project management skills in modern organizational context and maintain intellectual development through lifelong learning.

PEO-4: Exhibit team work with professionalism in their chosen profession and adapt to current trends, technologies suitable for industries.

PROGRAM OUTCOMES (POS)

PO-1: Assess the problems, gather data related to the problem, generate and prioritize a set of alternative solutions, and select and implement the best alternative incorporating the recommendations of relevant codes of practice.

PO-2: Design, analyze, conduct numerical experiments, and interpret data of compound automotive engineering related problems

PO-3: Develop automotive engineering practices and principles to a project and lead the team for efficient project management considering economical and financial factors

PO-4: Justify the impact of engineering solutions on environment and the need for sustainable development.

PO-5: Implement the relevant techniques, skills, advanced modern engineering tools, instrumentation and software packages necessary for engineering practices.

PO-6: Build competent technical knowledge to practice automotive engineering business and develop ideas to amalgamate the existing and contemporary knowledge.

PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO-1: Select, design, conduct experiments, and interpret data of an automotive system to meet the requirements of an automobile industry by using modern engineering tools and software.

PSO-2: Produce the appropriate techniques and modern engineering hardware and software tools in the design and integration of automotive system for the advancement of technology.

BOARD OF STUDIES

S.No	Name	Affiliation	Role
1	Dr. L.KARIKALAN	*Associate Professor and Head* Dept. of Automobile Engineering VISTAS, Chennai	Chairman
2	Dr. S.SATHISH	*Associate Professor* Dept. of Mechanical Engineering Hindustan Institute of Technology and Science, Chennai	Academic Expert
3	Mr. JEROME PETER MOHANDAS	*Chief Executive Officer* Jerry Motor Company, Chennai	Industrial Expert
4	Dr. M.CHANDRASEKARAN	*Director - Mechanical* Dept. of Mechanical Engineering VISTAS, Chennai	Internal Member
5	Dr. S.RAMASUBRAMANIAN	*Assistant Professor* Dept. of Automobile Engineering VISTAS, Chennai	Internal Member
6	Dr. M.RUBAN	*Assistant Professor* Dept. of Automobile Engineering VISTAS, Chennai	Internal Member

Regulation 2021

M.E. AUTOMOBILE ENGINEERING DEGREE COURSE

COURSES OF STUDY AND SCHEME OF ASSESSMENT

(MINIMUM CREDITS TO BE EARNED: 80)

		Hours/Week				Maximum Marks		
Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
SEMESTER I								
Program Core	Automotive Chassis and Transmission	3	1	0	4	40	60	100
Program Core	Automotive Engines and Accessories	3	1	0	4	40	60	100
Foundation Course	Applied Mathematics	3	1	0	4	40	60	100
Program Elective	Program Elective I	3	1	0	4	40	60	100
Program Core	Automotive Chassis Components Laboratory	0	0	4	2	40	60	100
Program Core	Automotive Engine Components Laboratory	0	0	4	2	40	60	100
Mandatory courses	Research Methodology and IPR	2	0	0	2	40	60	100
Audit Course	Technical Seminar I	0	0	0	0	40	60	100
		14	**4**	**8**	**22**			

		Hours/Week				Maximum Marks		
Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
SEMESTER II								
Program Core	Electric And Hybrid Vehicles	3	1	0	4	40	60	100
Program Core	Automotive Electrical and Electronics	3	1	0	4	40	60	100
Program Elective	Program Elective II	3	1	0	4	40	60	100
Program Elective	Program Elective III	3	1	0	4	40	60	100
Program Core	Performance & Emission Testing Laboratory	0	0	4	2	40	60	100
Program Core	Computer Aided Vehicle Design Laboratory	0	0	4	2	40	60	100
Program Core	Mini Project	0	0	4	2	40	60	100
Audit Course	Technical Seminar II	0	0	0	0	40	60	100
		12	**4**	**12**	**22**			

		Hours/Week				Maximum Marks		
Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
SEMESTER III								
Program Elective	Program Elective IV	3	1	0	4	40	60	100
Open Elective	Open Elective I	3	1	0	4	40	60	100
Internship	Internship	0	0	4	2	40	60	100
Project	Dissertation I	0	0	20	10	40	60	100
		6	**2**	**24**	**20**			

		Hours/Week				Maximum Marks		
Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
SEMESTER IV								
Project	Dissertation II	0	0	32	16	40	60	100
		0	**0**	**32**	**16**			

LIST OF PROGRAM CORE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	**T**utorial	**P**ractical	
21MAPC11	Automotive Chassis and Transmission	3	1	0	4
21MAPC12	Automotive Engines and Accessories	3	1	0	4
21MAPC13	Automotive Chassis Components Laboratory	0	0	4	2
21MAPC14	Automotive Engine Components Laboratory	0	0	4	2
21MAPC21	Electric And Hybrid Vehicles	3	1	0	4
21MAPC22	Automotive Electrical and Electronics	3	1	0	4
21MAPC23	Performance & Emission Testing Laboratory	0	0	4	2
21MAPC24	Computer Aided Vehicle Design Laboratory	0	0	4	2
21MAPC25	Mini Project	0	0	4	2

LIST OF PROGRAM ELECTIVE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
21MAPE01	Automotive Pollution and Control	3	1	0	4
21MAPE02	Vehicle Dynamics	3	1	0	4
21MAPE03	Vehicle Body Engineering	3	1	0	4
21MAPE04	Two and Three Wheelers	3	1	0	4
21MAPE05	Special Types of Vehicles	3	1	0	4
21MAPE06	Vehicle Control Systems	3	1	0	4
21MAPE07	Combustion Thermodynamics and Heat Transfer	3	1	0	4
21MAPE08	Simulation of IC Engines	3	1	0	4
21MAPE09	Engine Management Systems	3	1	0	4
21MAPE10	Automotive Air Conditioning System	3	1	0	4
21MAPE11	Alternative Fuels	3	1	0	4
21MAPE12	Vehicle maintenance	3	1	0	4
21MAPE13	Simulation of Vehicle systems	3	1	0	4
21MAPE14	Automotive Aerodynamics	3	1	0	4
21MAPE15	Automotive Safety	3	1	0	4
21MAPE16	Transport Management	3	1	0	4
21MAPE17	Automotive Electrical Technology	3	1	0	4
21MAPE18	IC Engine process Modelling	3	1	0	4
21MAPE19	Materials in Automotive Technology	3	1	0	4
21MAPE20	Modelling of vehicle systems	3	1	0	4
21MAPE21	Finite Element Methods in Automobile Engineering	3	1	0	4
21MAPE22	Electronics in Engine Management System	3	1	0	4
21MAPE23	Theory of Fuels and Lubricants	3	1	0	4
21MAPE24	Quality Control Process and Reliability	3	1	0	4

LIST OF OPEN ELECTIVE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
21MAGE01	Hydraulic and Pneumatic Systems	3	1	0	4
21MAGE02	Total Quality System and Engineering	3	1	0	4
21MAGE03	Robotics and Sensors	3	1	0	4
21MAGE04	Mechatronics in Manufacturing Systems	3	1	0	4
21MAGE05	Rapid Prototyping and Tooling	3	1	0	4

LIST OF FOUNDATION COURSES

Code No.	**Course**	**Hours / Week**			Credits
		Lecture	Tutorial	Practical	
21MAFC01	Applied Mathematics	3	1	0	4

LIST OF MANDATORY COURSES

Code No.	**Course**	**Hours / Week**			Credits
		Lecture	Tutorial	Practical	
21MAMC01	Research Methodology and IPR	2	0	0	2

LIST OF INTERNSHIP COURSES

Code No.	**Course**	**Hours / Week**			Credits
		Lecture	Tutorial	Practical	
21MAIT01	Internship	0	0	4	2

LIST OF PROJECT COURSES

Code No.	**Course**	**Hours / Week**			Credits
		Lecture	Tutorial	Practical	
21MAPR01	Dissertation - I	0	0	20	10
21MAPR02	Dissertation - II	0	0	32	16

21MAPC11	AUTOMOTIVE CHASSIS AND TRANSMISSION	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To understand the detailed concept, construction, operation of chassis components and various types of mechanical transmission components, hydrodynamic devices, hydrostatic devisees and automatic transmission system

UNIT I INTRODUCTION **12**

Automotive chassis, Elements of the Chassis, Layout with reference to power plant, steering location and drive, frames, consideration of various loads acting on the fame, Frameless constructional details, materials, testing of frames, integral body construction.

UNIT II FRONT AXLE STEERING SYSTEM **12**

Front axle type, rigid axle and split axle, Constructional Details, Materials, Front wheel geometry viz., camber, castor, kingpin inclination, toe-in and toe-out. Condition for true rollingmotion of road wheels during steering. Steering geometry. Ackermann and Davis steering. Construction details of steering linkages. Different types of steering gear box. Steering linkageslayout for conventional and independent suspensions. Turning radius, instantaneous centre, wheel wobble and shimmy. Over-steer and under-steer. Power and power assisted steering

UNIT III DRIVE LINE STUDY **12**

Effect of driving thrust and torque –reaction .Hotchkiss drives. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drive- different types. Two speed rear axle. Rear axle construction-full floating, three quarter floating and semi-floating arrangements. Differential-conventional type, Non-slip type, Differential locks and differential housing.

UNIT IV CLUTCH AND GEAR BOX **12**

Requirement of Transmission system. Different types of clutches: Principle, construction and operation of friction clutches. COURSE OBJECTIVE of the gear box. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & power and acceleration. Determination of gear box ratios for different vehicle applications. Different types of gear boxes.

UNIT V HYDRODYNAMIC DRIVES **12**

Principles, performance and limitations of fluid coupling Constructional details of a typical fluid coupling. Reduction of drag torque, Principle, construction and advantages of hydrodynamic torque converters. Performance characteristics, converter couplings. Multi- stage Torque converter and poly phase torque converter

TOTAL: 60 Hours

TEXT BOOKS:

1. K. Newton, W.Steeds and T.K.Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann,2004
2. P.M.Heldt, "Automotive Chassis", Chilton Co., New York, 1982.
3. W.Steed, "Mechanics of Road Vehicles", Illiffe Books Ltd., London. 1992.
4. Heldt P.M, Torque Converters, Chilton Book Co., 1992.

REFERENCES:

1. Harban Singh Rayat, "The Automobile", S. Chand & Co. Ltd, New Delhi, 2000.
2. G.J.Giles, "Steering Suspension and Tyres", Illiffe Books Ltd., London, 1975.
3. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 12th Edition, 2011.

4. G.B.S.Narang, "Automobile Engineering", Khanna Publishers, New Delhi, 5th Edition, 2014.
5. R.P.Sharma, "Automobile Engineering", Dhanpat Rai & Sons, New Delhi, 2000.
6. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002
7. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005

COURSE OUTCOMES:

CO1:	Compare the different types of frame and chassis used in Automotive.	**K3**
CO2:	Judge the different types of drive lines and drives used in Automotive.	**K3**
CO3:	Differentiate the types of front axle and rear axles used in motor vehicles.	**K4**
CO4:	Examine the working principle of conventional and independent suspension systems.	**K3**
CO5:	Distinguish the working principles of clutch, gearbox and hydrodynamic drives.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	3	3	2	-	-	-	-	-	-	-	1	2
CO 2	3	3	2	2	1	-	-	-	-	-	-	-	3	3
CO 3	2	2	1	1	1	-	-	-	-	-	-	-	2	2
CO 4	2	1	2	2	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	1	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
✓	✓		✓		✓

21MAPC12 AUTOMOTIVE ENGINES AND ACCESSORIES L T P C
3 1 0 4

COURSE OBJECTIVE:

To impart knowledge on various automotive engine types, its performance characteristics and engine subsystems.

UNIT I ENGINE BASIC THEORY 12

Engine types - operating cycles of SI and CI Engines - Engine design and operating parameters - Two and four stroke engines - Typical performance curves for automobile engines- two stroke engine - performance and pollution aspects.

UNIT II FUEL SUPPLY AND IGNITION SYSTEM 12

Fuel supply system of I.C. engine and elements, Theory of carburetion and carburetors — Design aspects — Petrol Injection and diesel fuel injection - pumps and injectors, gasoline direct injection system - conventional and electronic ignition systems for SI engine.

UNIT III COOLING AND LUBRICATING SYSTEM 12

Air cooling and water cooling – thermosympon cooling, forced cooling systems. Fins and radiator - design aspects. Theory of lubrication — types of lubrication, splash lubrication system, petroil lubrication system, forced feed lubrication system.

UNIT IV AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS 12

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

UNIT V NEW ENGINE TECHNOLOGY 12

Lean Burn engine – Different approaches to lean bum – LHR engine – Surface ignition concept – catalytic ignition – homogenous charge compression ignition in diesel engines – variable valve timing - electronic engine management.

TOTAL: 60 Hours

TEXTBOOKS:

1. J.B.Heywood, 'Internal combustion engine Fundamentals', McGraw Hill Book Co, 1989.
2. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, 3rd Edition, 2007.

REFERENCES:

1. Edward F.Obert, 'Internal combustion engines and air pollution' Harber and Row Publishers, 1973.
2. M.Khovakh, 'Motor Vehicle Engines', Mir Publishers, Mascow,1976
3. W.H.Crouse and A.L.Anglin, 'Automotive Emission control', McGraw Hill Book Co, 1995.

COURSE OUTCOMES:

CO1:	Use the I.C engine basics	K3
CO2:	Distinguish the fuel and ignition system thoroughly	K3
CO3:	Demonstrate the knowledge on cooling and lubricating system	K4
CO4:	Differentiate the air motion combustion and combustion chambers	K3
CO5:	Develop the knowledge on new engine technology	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	3	3	2	-	-	-	-	-	-	-	1	2
CO 2	3	3	2	2	1	-	-	-	-	-	-	-	3	3
CO 3	2	2	1	1	1	-	-	-	-	-	-	-	2	2
CO 4	2	1	2	2	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	1	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
✓	✓		✓		✓

21MAPC13	AUTOMOTIVE CHASSIS COMPONENTS LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVE:

To train the students to know the details of different chassis components, dismantling and assembling them.

LIST OF EXPERIMENTS

1. Study and measurement of Heavy-duty vehicle frame (Leyland, Tata etc)
2. Study and measurement of Light duty vehicle frame (Ambassador, Maruti van etc)
3. Dismantling and assembling of Front Axle
4. Dismantling and assembling of Front Rear Axle
5. Dismantling and assembling of Differential
6. Dismantling and assembling of Steering Gearbox
7. Study of Braking systems – hydraulic servo vacuum, compressed air power brakes.
8. Study of Leaf spring, coil spring, torsion bar spring, Hydraulic shock absorber
9. Dismantling and assembling of Diaphragm Clutch assembly
10. Dismantling and assembling of Gear Box and Transfer case

THE LIST OF EQUIPMENTS - Each 1 No (For a batch of 15 Students)

1. Heavy duty vehicle chassis frame (Leyland or Tata)
2. Light duty vehicle chassis frame
3. Front axle
4. Rear axle
5. Steering system
2. Steering gear box (Rack and pinion, re-circulating Ball type)
3. Hydraulic brake system
4. Air brake system
5. Leaf spring, coil spring, torsion bar
6. Hydraulic shock absorber
7. Diaphragm clutch assembly
8. Gear box (light duty, heavy duty)
9. Transfer case

TOTAL: 30 Hours

Text Books:

1. K. Newton, W. Steeds and T.K. Garret, "The Motor Vehicle", 13th Edition, ButterworthHeinemann, India, 2004.
2. P.M. Heldt, "Automotive Chassis", Chilton Co., New York, 1982.

Reference Books:

1. Harban Singh Rayat, "The Automobile", S. Chand & Co. Ltd, New Delhi, 2000.
1. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.

Weblinks:

- https://nptel.ac.in/courses/107106088

COURSE OUTCOMES

CO1:	Describe the Heavy-duty vehicle frame	**K3**
CO2:	Describe the Light duty vehicle frame	**K3**
CO3:	Demonstrate the dismantling and assembling of Front Axle, Rear Axle and Differential	**K3**
CO4:	Define the Steering systems along with any two types of steering gear box	**K3**
CO5:	Explain the Braking systems – hydraulic servo vacuum, compressed air power brakes	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	1	3	-	-	-	-	1	-	-	2	1
CO2	3	1	-	2	3	-	-	-	-	1	-	-	2	-
CO3	2	2	-	2	3	-	-	-	-	1	-	-	3	-
CO4	3	3	-	2	3	-	-	-	-	2	-	-	3	2
CO5	3	3	1	3	3	-	1	-	-	2	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration /Presentation	Open book test
			✓	✓	

21MAPC14	AUTOMOTIVE ENGINE COMPONENTS LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVE:

To train the Students to know the details of different engine components, dismantling and assembling them.

LIST OF EXPERIMENTS

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

LIST OF EQUIPMENTS - Each 1 No

1. Four cylinder petrol engine
2. Six cylinder diesel engine
3. Fuel filter, fuel injection pump, injector, carburetor, MPFI component
4. Ignition coil, magneto, electronic ignition system components
5. Water pump, thermostat, radiator, temperature gauge
6. Lub oil pump, pressure relief valve, filter, oil pressure gauge
7. Internal micrometer, external micrometer, dial gauges.

TOTAL: 30 Hours

COURSE OUTCOMES

CO1:	Demonstrate the knowledge on designing components towithstand the loads and deformations.	**K3**
CO2:	Synthesize, analyze and document the design of the various components	**K3**
CO3:	Demonstrate the ability to use engineering techniques fordeveloping vehicle components with industry standards	**K3**
CO4:	Perform the design of the crankshaft, balancing weightcalculations.	**K3**
CO5:	Understand the complete methodology of design &drafting.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	-	-	-	-	2	-	2	2	2
CO2	2	2	2	2	3	-	-	-	-	3	-	2	2	3
CO3	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO4	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO5	3	2	2	2	2	-	-	-	-	2	-	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration /Presentation	Open book test
			✓	✓	

21MAPC21	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To understand how a hybrid vehicle works and describe the operating principle for fuel cells and energy storage elements and calculate basic performance of them.

UNIT I INTRODUCTION 12

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 12

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 12

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 12

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

TOTAL: 60 Hours

TEXTBOOKS/ 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. Lino Guzzella, “Vehicle Propulsion System” Springer Publications,2005
5. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2005

COURSE OUTCOMES:

CO1:	Review the different configurations of hybrid and electric vehicles	**K3**
CO2:	Design the basic schemes of electric vehicles and hybrid electric vehicles.	**K3**
CO3:	Select the proper energy storage systems for vehicle applications	**K4**
CO4:	Judge a suitable drive for developing an electric hybrid vehicle depending on resources	**K5**
CO5:	Examine the basic operation of power-split device in hybrid electric vehicle.	**K3**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	1	1	2	1	-	-	1	-	1	3	2
CO2	3	3	1	1	2	-	-	-	-	1	-	2	3	1
CO3	2	1	2	2	1	3	3	2	-	2	1	1	-	2
CO4	2	-	1	1	1	3	2	1	-	2	2	1	1	2
CO5	2	1	1	1	1	2	0	-	-	1	-	1	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓	✓	✓

21MAPC22 AUTOMOTIVE ELECTRICALS AND ELECTRONICS L T P C
3 1 0 4

COURSE OBJECTIVE:

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

UNIT I BATTERIES AND STARTING SYSTEM 12

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

UNITII CHARGING SYSTEM, LIGHTING SYSTEM AND ACCESSORIES 12

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

UNIT III ELECTRONIC IGNITION AND INJECTION SYSTEMS 12

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

UNIT IV SENSORS IN AUTOMOBILES 12

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

UNIT V MICROPROCESSOR IN AUTOMOBILES 12

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

TOTAL: 60 Hours

TEXT BOOKS:

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

REFERENCES:

1. G.W.Vinal, Storage Batteries, John Wiley & Sons inc., New York, 1985.
2. W.H.Crouse, Automobile Electrical Equipment, McGraw Hill Book Co Inc., New York, 1980.

3. Robert N Brady Automotive Computers and Digital Instrumentation, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.
4. P.L.Kohli , "Automotive Electrical Equipment", Tata McGraw Hill Publishing Co., Delhi, 2004
5. Tom Denton, 'Automobile Electrical and Electronic Systems', Routledge press , 2013.

COURSE OUTCOMES

CO1:	Acquire the knowledge of Electrical and Electronics engineering concepts	**K3**
CO2:	Understand the purpose, construction and working of differentbatteries and electrical systems used in Automobiles	**K3**
CO3:	Identify, demonstrate and compare the various components andsystems of Auto electrical systems	**K4**
CO4:	Obtain an overview of automotive components, subsystems,design cycles, communication protocols	**K3**
CO5:	Interface automotive sensors and actuators withmicrocontrollers	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	3	1	1	1	-	-	-	-	-	-	-	2	3
CO 3	2	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 4	3	2	1	2	1	-	-	-	-	-	-	-	3	2
CO 5	3	2	2	2	1	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
✓	✓		✓		✓

21MAPC23	PERFORMANCE AND EMISSION TESTING LAB	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

To conduct performance test and emission test on the IC engines.

LIST OF EXPERIMENTS

1. Study of Pressure pickups, charge amplifier, storage oscilloscope and signal analyzers used for IC engine testing.
2. Performance study of petrol and diesel engines both at full load and part load conditions.
3. Morse test on petrol and diesel engines.
4. Determination of compression ratio, volumetric efficiency and optimum cooling water flowrate in engines.
5. Heat balance test on an automotive engine.
6. Testing of 2 and 4 wheelers using chassis dynamometers.
7. Study of NDIR Gas Analyzer and FID
8. Study of Chemiluminescent NOx analyzer
9. Measurement of HC, CO, CO2, O2 using exhaust gas analyzer
10. Diesel smoke measurement.

TOTAL: 30 Hours

COURSE OUTCOMES

CO1:	Define the Pressure pickups, charge amplifier, storage oscilloscope and signal analyzers	K3
CO2:	Define the Pressure pickups, charge amplifier, storage oscilloscope and signal analyzers	K3
CO3:	Evaluate the performance of petrol and diesel engines both at full load and part load conditions	K4
CO4:	Perform the Morse test on petrol and diesel engines	K3
CO5:	Perform the Heat balance test on an automotive engine	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	-	-	-	-	2	-	2	2	2
CO2	2	2	2	2	3	-	-	-	-	3	-	2	2	3
CO3	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO4	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO5	3	2	2	2	2	-	-	-	-	2	-	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration /Presentation	Open book test
			✓	✓	

21MAPC24	COMPUTER AIDED VEHICLE COMPONENTS DESIGN LABORATORY	L T P C 0 0 4 2

COURSE OBJECTIVE:

To learn the basic procedures of computer aided design related to automobile componentsDesign calculation, model and analyze the following automobile components

1. Piston, piston pin and piston rings
2. Connecting rod.
3. Automobile valves
4. Crank shaft
5. Cam shaft
6. Vehicle Chassis
7. Leaf spring, coil spring and torsion bar.
8. Front axle system of a typical 4 Wheeled vehicle
9. Rear axle system of a typical 4 wheeled vehicle
10. Three speed and four speed gear boxes of a heavy vehicle

THE LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1. Computer nodes - 25 Nos.
2. Software like CATIA or Pro-E – 20 licenses

TOTAL: 30 Hours

COURSE OUTCOMES

CO1:	Demonstrate the knowledge on designing components towithstand the loads and deformations.	**K3**
CO2:	Synthesize, analyze and document the design of the various components	**K3**
CO3:	Demonstrate the ability to use engineering techniques fordeveloping vehicle components with	**K3**
	industry standards	
CO4:	Perform the design of the crankshaft, balancing	**K3**
	weightcalculations.	
CO5:	Understand the complete methodology of design &drafting.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	-	-	-	-	2	-	2	2	2
CO2	2	2	2	2	3	-	-	-	-	3	-	2	2	3
CO3	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO4	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO5	3	2	2	2	2	-	-	-	-	2	-	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration /Presentation	Open book test
			✓	✓	

21MAPC25	MINI PROJECT	L	T	C	P
		0	0	2	4

COURSE OBJECTIVE:

The objective of the project work is to enable the students on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in thetime of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines. The continuous assessment shall be made as prescribed by the regulation.

21MAMC01	APPLIED MATHEMATICS	L T P C 3 1 0 4

COURSE OBJECTIVE:

To equip the students with standard concepts and tools at an advanced level of mathematics and applications that they would find useful in their disciplines

UNIT I MATRIX THEORY **12**

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

UNIT II DIFFERENTIAL EQUATIONS **12**

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

UNIT III CALCULUS OF VARIATION **12**

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

UNIT IV INTERPOLATION AND INTEGRATION **12**

Hermite's Interpolation, Simple case and General case – Cubic Spline Interpolation, Algorithm of interpolating cubic spline – Gaussian Qundraline – Cubature.

UNIT V LINEAR PROGRAMMING PROBLEM **12**

Simplex algorithm, Fundamental property of the simplex method – Graphical, Two phase and Big M Techniques – Duality theory – Dual simplex method – Integer programming.

TOTAL: 60 Hours

TEXT BOOKS:

1. G.Stephenson, P.M.Radmore, Advanced Mathematical Methods for Engineering and Science students, Cambridge University Press 1999.
2. R.Bronson, Matrix Operations, Schaum's outline series, McGraw Hill, New York, 1989.
3. E.Kreyszig, Advanced Engineering Mathematics, John Wiley, 10th Edition, 2011.

REFERENCES:

1. C.E.Froberg, Numerical Mathematics, The Benjaminn/Cummings Pulblishing Co., Inc., 1985.
2. M.K. Jain, S.R.K. Iyengar, and R.K. Jain, Numerical Methods for Scientific & Engineering computation, Wiley Eastern Ltd., 1987.
3. A.S. Gupta, Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
4. K. Sankara Rao, Introduction to Partial Differential Equations, Prentice Hall of India Pvt Ltd., New Delhi 1997.
5. Boyce & Di Prima, Elementary Differential Equations and Boundary value problems, with ODE Architect CD, 9th Edition, 2014.

COURSE OUTCOMES

CO1:	Develop the use of Fourier transformation	**K3**
CO2:	Select the concepts of differential equations	**K4**
CO3:	Evaluate the concepts of Calculus of Variations	**K3**
CO4:	Construct the concepts of interpolation and integration	**K4**
CO5:	Classify the linear programming problem.	**K3**

MAPPING OF PROGRAM OUTCOME TO COURSE OUTCOME:

	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	1	1	-	1	-	-
CO2	2	1	1	1	2	-	-	-	-	1	-	1	2	-
CO3	2	1	1	1	2	-	-	-	-	1	-	1	2	-
CO4	1	1	1	1	2	-	-	-	-	1	-	1	1	1
CO5	1	1	1	1	2	-	-	-	-	1	-	1	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
✓	✓		✓	✓	✓

21MAPE01 AUTOMOTIVE POLLUTION AND CONTROL L T P C
3 1 0 4

COURSE OBJECTIVE:

To impart knowledge on automotive pollutant formation, control and to impart knowledge on various emission instruments and techniques

UNIT I EMISSION FROM AUTOMOBILES 12

Vehicle population assessment in metropolitan cities and contribution to pollution, effects on human health and environment, global warming, various emissions from Automobiles — Formation, transient operational effects on pollution.

UNIT II EMISSIONS FROM SPARK IGNITION ENGINE AND ITS CONTROL 12

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

UNIT III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL 12

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

UNIT IV NOISE POLLUTION FROM AUTOMOBILES 12

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

UNIT V TEST PROCEDURES AND EMISSION MEASUREMENTS 12

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

TOTAL: 60 Hours

TEXT BOOKS:

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

REFERENCES:

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, 3rd Edition, 2007.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company., Newyork 1993.
3. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
4. C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.

5. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise', Applied science publisher ltd., London,1987
6. Chilton, 'Automotive Emission Controls Manual', Haynes Techbooks, 1st Edition, 2014.

COURSE OUTCOMES

CO1:	Analyze the impact of vehicle population on pollution	**K4**
CO2:	Describe the emission and its effect on human health andenvironment	**K3**
CO3:	Describe the formation of pollutant in SI engine	**K3**
CO4:	Identify the formation of pollutant in CI engine	**K4**
CO5:	Clearly explain the various noise and noise reduction inautomobile	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	1	1	3	2	2	-	-	-	-	-	1	1
CO 2	2	2	2	2	1	-	1	-	-	-	-	-	2	2
CO 3	2	1	1	2	3	-	1	-	-	-	-	-	2	1
CO 4	1	3	2	1	1	2	1	-	-	-	-	-	1	3
CO 5	2	2	2	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE02	VEHICLE DYNAMICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To study and understand the various vibrating elements of a vehicle how to reduce the vibration under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle.

UNIT I BASIS OF VIBRATION 12

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, Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed. Modal analysis

UNIT II TYRES 12

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. Tyre vibration.

UNIT III VERTICAL DYNAMICS 12

Human response to vibration, Sources of Vibration. Design, analysis and computer 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 12

Aerodynamic forces and moments. Equation of motion. Tyre forces, rolling resistance, Load distribution for three wheeler and four wheeler. Calculation of Maximum acceleration, Reaction forces for Different drives. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control. Case Studies.

UNIT V LATERAL DYNAMICS 12

Steady state handling characteristics. Steady state response to steering input. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle under side forces. Stability of vehicle on banked road and during turn. Effect of suspension on cornering.

TOTAL: 60 Hours

TEXT BOOKS:

1. Singiresu S. Rao, Mechanical Vibrations (5th Edition), Prentice Hall, 2010
2. J. Y. Wong, Theory of Ground Vehicles, 3rd Edition, Wiley-Interscience, 2001
3. Rajesh Rajamani, Vehicle Dynamics and Control, 1st edition, Springer, 2005

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. Michael Blundell & Damian Harty, The Multibody Systems Approach to Vehicle Dynamics, Elsevier Limited, 2004
4. Hans B Pacejka, Tyre and Vehicle Dynamics, 2nd edition, SAE International, 2005

COURSE OUTCOMES

CO1:	Describe the vehicle vibration and simulation modeling	**K3**
CO2:	Define the vehicle degrees of freedom	**K3**
CO3:	Describe the force and moment on tyre	**K3**
CO4:	Clearly explain the tyre properties	**K3**
CO5:	Familiar with the Aerodynamics forces and moments	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	3	3	2	-	-	-	-	-	-	-	1	2
CO 2	3	3	2	2	1	-	-	-	-	-	-	-	3	3
CO 3	2	2	1	1	1	-	-	-	-	-	-	-	2	2
CO 4	2	1	2	2	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	1	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE03	VEHICLE BODY ENGINEERING	L T P C 3 1 0 4

COURSE OBJECTIVE:

To impart knowledge in the construction of vehicle, aerodynamic, concept, paneling of passenger vehicles. 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 12

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. Safety aspect of car body.

UNIT II BUS BODY 12

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

UNIT III COMMERCIAL VEHICLE BODY 12

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

UNIT IV VEHICLE AERODYNAMICS 12

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.

UNIT V BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR 12

Types of materials used in body construction-Steel sheet, wood, aluminum, plastics, composites, properties of materials. Body trim items-body mechanisms. Hand tools - power tools -panel repair-repairing sheet metal-repairing plastics-body – corrosion: Anticorrosion methods, Modern painting process procedure-paint problems

TOTAL: 60 Hours

COURSE OUTCOME:

CO-1: Construct the different aspects of car body.

CO-2: Select the bus body and commercial vehicle bodies.

CO-3: Classify the role of various aerodynamic forces & moments.

CO-4: Implement the material used in body building.

CO-5: Summarize the tools used in body repairs

TEXTBOOK:

1. J. Powloski, Vehicle Body Engineering, Business Books Ltd., 1998.
2. James E Duffy, Body Repair Technology for 4-Wheelers, Cengage Learning,2009.

REFERENCES:

1. G.J. Giles, Body construction and design, Illiffe Books Butterworth & Co., 1991.
2. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd., London, 1992.
3. Dieler Anselm., The passenger car body, SAE International, 2000

COURSE OUTCOMES

CO1:	Describe the concept of car body design	**K3**
CO2:	Explain the passenger safety, crumple zone and crash testing	**K3**
CO3:	Explain the concepts of wind tunnel testing	**K3**
CO4:	Analyze vehicle body optimization techniques to reduce drag	**K4**
CO5:	Familiar with the various types of bus body construction	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO 1	1	1	2	2	2	-	-	-	-	-	-	-	1	1
CO 2	3	2	1	3	3	-	-	-	-	-	-	-	3	2
CO 3	2	2	1	3	1	-	-	-	-	-	-	-	2	2
CO 4	3	1	2	2	3	-	-	-	-	-	-	-	3	1
CO 5	1	2	1	3	2	-	-	-	-	-	-	-	1	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE04	TWO AND THREE WHEELERS	L T P C 3 1 0 4

COURSE OBJECTIVE:

To study and understand the constructional details, operating characteristics and design aspects of two and three wheelers.

UNIT I INTRODUCTION **12**

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

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

2 stoke and 4 stoke SI engines and CI engines design criteria for engines – design of cylinders, cylinder head, cooling fins, crank case, connecting rod and crank shaft. Carburettor types and design. Battery coil ignition, magneto ignition and electronic ignition. Lighting and other electrical system.

UNIT III CLUTCHES AND TRANSMISSION **12**

Clutch, Types of clutches for 2 and 3 wheelers. Design of clutch system. Gears for two and three wheelers. Design of gear box and gear change mechanism. Belt drive, chain drive and shaft drive. Freewheeling devices, starting systems.

UNIT IV FRAMES, SUSPENSION, WHEELS AND TYRES **12**

Types of frames used for two wheelers. Wheel frames- construction design of frames for fatigue strength torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details of wheel and tyres.

UNIT V THREE WHEELERS **12**

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

TOTAL: 60 Hours

TEXT BOOKS:

1. P.E. Irving, "Motor Cycle Engineering", Temple Press Book, London, 1964.
2. Marshal Cavandedish, 'Encyclopedia of Motor cycling', New York, 1989
3. S.Srinivasan, 'Motor cycle, Scooter, Mobeds', New century book house, 1988.

REFERENCES:

1. M.M.Griffin., 'Motor cycles from inside and outside', Prentice Hall Inc, New Jersey, 1978.
2. Servicing Manuals- various motor cycles, Scooters, Mopeds and three wheelers.

COURSE OUTCOMES

CO1:	Clearly explain the scavenging processes	**K3**
CO2:	Explain the electronic ignition system	**K3**
CO3:	Familiar with the shaft drive	**K3**
CO4:	Describe the Suspension system	**K3**
CO5:	Familiar with the different types of brake	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	2	1	1	-	-	-	-	-	-	-	1	2
CO 2	3	1	3	2	1	-	-	-	-	-	-	-	3	1
CO 3	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO 4	2	1	1	1	1	-	-	-	-	-	-	-	2	1
CO 5	2	1	1	2	1	-	-	-	-	-	-	-	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
✓	✓		✓		✓

21MAPE05	SPECIAL TYPE OF VEHICLES	L T P C 3 1 0 4

COURSE OBJECTIVE:

To study the various types of special type of vehicles, construction, various components and their functions

UNIT I EARTH MOVING AND CONSTRUCTIONAL EQUIPMENTS 12

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

UNIT II POWER TRAIN CONCEPTS 12

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

UNIT III VEHICLE SYSTEMS, FEATURES 12

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

UNIT IV SPECIAL PURPOSE VEHICLES FOR INDUSTRIAL APPLICATIONS 12

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

UNIT V FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES 12

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

TOTAL: 60 Hours

COURSE OUTCOME:

CO-1: Classify the basics of earth moving and construction equipment's

CO-2: Apply the concept and working of power train.

CO-3: Explain the working principle of vehicle systems.

CO-4: Identify the applications of special purpose vehicle

CO-5: List the need of farm equipment's, military and combat vehicles.

TEXT BOOKS/REFERENCES:

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

COURSE OUTCOMES

CO1:	Describe the various earth-moving equipment	**K3**
CO2:	Familiar with the vehicle performance characteristics	**K4**
CO3:	Describe the converter match curves	**K3**
CO4:	Explain the constructional details of steerable and drive axlesof dumper	**K3**
CO5:	Define the OCDB and dry disc caliper brakes	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	2	1	1	2	2	-	-	-	-	-	-	-	2	1
CO 3	-	2	2	1	1	-	-	-	-	-	-	-	-	2
CO 4	2	1	1	2	2	-	-	-	-	-	-	-	2	1
CO 5	1	1	2	2	1	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE06	VEHICLE CONTROL SYSTEMS	L T P C 3 1 0 4

COURSE OBJECTIVE:

The main objective of the course is to provide a good knowledge to the vehicle control systems for the students and to provide a wider idea to the vehicle driveline control system, safety and security system and intelligent transportation system.

UNIT I INTRODUCTION **12**

Chassis, types, components of chassis management system – role of various sensors and actuators pertain to chassis system – Advantages and Disadvantages, construction – working principle.

UNIT II DRIVELINE CONTROL SYSTEM **12**

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

UNIT III SAFETY AND SECURITY SYSTEM **12**

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 **12**

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 **12**

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: 60 Hours

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

CO1:	Understand the fundamentals of automotive electronics	**K3**
CO2:	Understand the role of various sensors, its construction and workingprinciple	**K3**
CO3:	Familiar with the Security and safety system	**K4**
CO4:	Familiar with the comfort system	**K5**
CO5:	Familiar with the Vehicle Management system	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	1	1	1	1	3	2	2	-	-	-	-	-	1	1
CO 2	2	2	2	2	1	-	1	-	-	-	-	-	2	2
CO 3	2	1	1	2	3	-	1	-	-	-	-	-	2	1
CO 4	1	3	2	1	1	2	1	-	-	-	-	-	1	3
CO 5	2	2	2	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE07	COMBUSTION THERMODYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

The main objective of the course is to provide a good knowledge to understand the mechanisms of combustion engine and understand the concepts of heat transfer through extended surfaces of vehicle system.

UNIT I THERMODYNAMICS OF COMBUSTION **12**

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

UNIT II CHEMICAL KINETICS OF COMBUSTION **12**

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

UNIT III FLAMES **12**

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

UNIT IV HEAT TRANSFER IN IC ENGINES **12**

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

UNIT V EXPERIMENTS IN IC ENGINES **12**

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

TOTAL: 60 Hours

TEXTBOOKS/REFERENCES:

1. D.B. Spalding, "Some fundamental of Combustion", Butterworth Science Publications, London, 1985.
2. B. Lewis, R.N. Pease and H.S. Taylor, "Combustion Process High Speed Gas Dynamics and Jet Propulsion Series ", Princeton University Press, Princeton, New Jersey, 1976.
3. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
4. J.l.Ramos, "Modeling of Internal Combustion Engine", Mcgraw hill book company New york 1990
5. B. John, Heywood,'Internal Combustion Engines'", Tata McGraw Hill Co., Newyork, 1988.

COURSE OUTCOMES:

CO1:	Examine the thermodynamics of combustion	**K3**
CO2:	Apply the chemical kinetics of combustion	**K3**
CO3:	Use the concept of flames	**K4**
CO4:	Explain the heat transfer in I.C engines	**K5**
CO5:	State the experiments performed in I.C engines	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	3	3	3	3	3	3
CO2	3	3	2	2	-	-	-	-	2	2	2	2	3	2
CO3	3	2	3	2	-	-	-	-	2	2	2	2	3	1
CO4	2	2	3	3	-	-	-	-	3	2	2	3	2	3
CO5	2	3	3	2	-	-	-	-	3	2	3	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
✓	✓		✓	✓	✓

21MAPE08	SIMULATION OF IC ENGINES	L T P C 3 1 0 4

COURSE OBJECTIVE:

The main objective of this course is to impart knowledge in computer simulation of IC engine Process.

UNIT I INTRODUCTION **12**

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

UNIT II COMBUSTION STOICHIOMETRY **12**

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

UNIT III ADIABATIC FLAME TEMPERATURE **12**

Introduction, complete combustion C/H/N/O/ systems, constant – volume adiabatic combustion, constant – pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state. SI Engine simulation with air as working medium, deviation between actual and ideal cycle.

UNIT IV SI ENGINE SIMULATION WITH ADIABATIC COMBUSTION **12**

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

UNIT V SI ENGINE SIMULATION WITH GAS EXCHANGE PROCESS **12**

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

TOTAL: 60 Hours

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

CO1:	Describe the classifications and applications of engine cycle simulation model	**K3**
CO2:	Grasp the major modeling and simulation methods and theinfluence of model	**K4**
CO3:	Familiar with the modeling of filling/ emptying method and ability to build up control-oriented simulation model	**K3**
CO4:	Familiar with the essential models of engine cycle simulation and calculation of engine parameters	**K3**
CO5:	Simulate the different engine processes	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 3	2	2	2	3	1	-	-	-	-	-	-	-	2	2
CO 4	2	1	1	2	2	-	-	-	-	-	-	-	2	1
CO 5	3	2	1	1	2	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE09	ENGINE MANAGEMENT SYSTEM	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To explain the principle of engines electronic management system and different sensors used in the systems and understand the real time engine management system

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 12

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

UNIT II SENSORS AND ACTUATORS 12

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

UNIT III SI ENGINE MANAGEMENT 12

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

UNIT IV CI ENGINE MANAGEMENT 12

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

UNIT V DIGITAL ENGINE CONTROL SYSTEM 12

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

TOTAL: 60 Hours

TEXT BOOKS:

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

REFERENCES:

1. Robert Bosch,'Diesel Engine Management', SAE Publications, 3rd Edition, 2004.
2. Robert Bosch, 'Gasoline Engine Management', SAE Publications, 2nd Edition, 2004
3. Lino Guzzella, Christopher Onder, 'Introduction to Modeling and Control of Internal Combustion Engine Systems', Springer Science & Business Media, 2009.
4. Konrad Reif, 'Diesel Engine Management: Systems and Components', Springer, 2014.

COURSE OUTCOMES:

CO1:	Explain the various sensors and actuators used in engine management systems.	**K3**
CO2:	Differentiate the fundamentals, operation, function of various fuel injection systems	**K3**
CO3:	Explain the control algorithm during various engine operating conditions.	**K4**
CO4:	Summarize the various ignition systems and different injection systems	**K5**
CO5:	List the various engine control algorithm used during engine operation.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	1	1	1	1	3	2	2	-	-	-	-	-	1	1
CO 2	2	2	2	2	1	-	1	-	-	-	-	-	2	2
CO 3	2	1	1	2	3	-	1	-	-	-	-	-	2	1
CO 4	1	3	2	1	1	2	1	-	-	-	-	-	1	3
CO 5	2	2	2	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE10	AUTOMOTIVE AIR CONDITIONING SYSTEM	L T P C 3 1 0 4

COURSE OBJECTIVE:

To study the Knowledge of eco-friendly refrigerants, refrigeration and air conditioning systems

UNIT I FUNDAMENTALS OF AIR-CONDITIONING, COOLING AND HEATING SYSTEM 12

Basic terminology, design factors and concepts related to air conditioning system - Construction and Working principles of Thermostatic Expansion valve and Orifice tube based system- Heating system types -detailed study of HVAC components like compressor, evaporator, condenser, TXV, orifice tube , Receiver-drier, heater core etc. Location of air conditioning components in a vehicle.

UNIT II REFRIGERANTS & AIR MANAGEMENT SYSTEMS 12

Refrigerants: Temperature and pressure relation, Properties of R-13 and R134a- refrigerant oil Simple problems - Containers - Handling refrigerants - Tapping into the refrigerant container - Ozone Layer Depletion.

Air management system: Air routing for manual, semi and automatic system- cases and ducts- Air distribution, control head and doors- Defrost system

UNIT III AUTOMATIC CLIMATE CONTROL SYSTEM 12

ATC system block diagram- different types of Sensors and Actuators, - Control Logic Electrical wiring diagram of manual and automatic system - multiplexing between BCM and PCM- control of compressor clutch, blower motor etc.- diagnostics tools and features.

UNIT IV MODELING OF AIR-CONDITIONING COMPONENTS 12

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 12

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.

TOTAL: 60 Hours

TEXT BOOKS:

1. Tom Birch, “Automotive Heating and Air Conditioning” Pearson Education Inc., 2003.
2. Boyce H. Dwiggins, Jack Erjavec., “Automotive Heating and Air-Conditioning”, Delmer publisher, 2001.
3. William H Crouse and Donald L Anglin, “Automotive air conditioning”, McGraw - Hill Inc., 1990.

REFERENCES:

1. L.F. Goings, “Automotive air conditioning”, American Technical services, 1974
2. Paul Weiser, “Automotive air conditioning”, Reston Publishing Co Inc., 1990.
3. K.L. MacDonald, “Automotive air conditioning”, Theodore Audel series, 1978.

4. James D. Halderman, "Automotive Heating, Ventilation, and Air Conditioning Systems", Pearson Education Inc., 2004.
5. SAE paper No: 931131,900084, 850040,931137,870029 etc.
6. Steven Daly, 'Automotive Air Conditioning and Climate Control Systems', Butterworth-Heinemann, 2011.
7. Vehicle service manuals.

COURSE OUTCOMES:

CO1:	List and explain the air conditioning components.	**K3**
CO2:	Clearly explain the air conditioning protection.	**K3**
CO3:	Familiar with the handling refrigerants & diagnostic procedure.	**K4**
CO4:	Describe the ambient conditions affecting system pressures.	**K5**
CO5:	Clearly explain the air conditioner maintenance and service.	**K3**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

PO→	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	3	2	1	1	2	-	2	-	-	1	-	-	3	3
CO 2	3	2	-	1	2	1	2	-	1	-	-	1	3	3
CO 3	3	2	-	-	2	-	2	-	-	-	-	-	3	1
CO 4	2	3	3	2	3	2	2	2	1	2	1	1	1	3
CO 5	3	2	1	2	3	1	3	1	-	2	1	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓	✓	✓

21MAPE11	ALTERNATIVE FUELS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To gain the knowledge of the engineering issues and perspectives affecting engine for using alternate flues in an engine.

UNIT I CONVENTIONAL FUELS FOR I.C. ENGINES 12

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 12

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 12

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 12

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 12

Biogas, C o m p r e s s e d Natural gas (CNG) and LPG – Properties and production methods. CO2 and H2S 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: 60 Hours

TEXT BOOKS:

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
3. Biodiesel”, Springer-Verlag London Limited 2010.
4. Ayhan Demirbas, ‘Biodiesel A Realistic Fuel Alternative for Diesel Engines’, Springer- Verlag London Limited 2008
5. David M. Mousdale, “Introduction to Biofuels”, CRC Press, 2015.
6. M. K. Gajendra Babu and K. A. Subramanian, “Alternative Transportation Fuels-Utilisation in Combustion Engines”, CRC Press, 2013.
7. M.L. Mathur, R.P.Sharma “A course in internal combustion engines”, Dhanpatrai publication, 2003.

REFERENCES:

1. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.
2. Donald Klass, Biomass for Renewable Energy, Fuels, and Chemicals, 1998, Academic Press, ISBN: 978-0-12-410950-6.
3. Ayhan Demirbas, ' Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008,ISBN-13: 9781846289941
4. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
5. Technical papers of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).

COURSE OUTCOMES

CO1:	Describe the need of the alternative fuels	**K3**
CO2:	Explain the need of the Gaseous fuels	**K3**
CO3:	Describe and ethanol usage, storage, chemical structure, prosand cons	**K3**
CO4:	Evaluate the performance characteristics of alcohols fuels	**K4**
CO5:	Describe the natural gas, LPG, hydrogen, and biogas	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	3	3	2	1	-	-	-	-	-	-	-	3	3
CO 2	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO 3	1	2	1	2	1	-	-	-	-	-	-	-	1	2
CO 4	2	1	2	1	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE12 **VEHICLE MAINTENANCE** **L T P C**
3 1 0 4

COURSE OBJECTIVE:
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 12
Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

UNIT II POWER PLANT REPAIR AND OVERHAULING 12
Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system,- lubrication system. Power plant trouble shooting chart.

UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS 12
Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY 12
Vehicle body and types, Vehicle body panel tools for repairing and maintenance. Vehicle body Tinkering and painting. Use of soldering, metalloid paste.

UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS 12
Care, maintenance, testing and troubleshooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

TOTAL: 60 Hours

TEXT BOOKS/ REFERENCES:

1. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London, 1969.
2. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi, 1986.
3. Vehicle servicing manuals.

COURSE OUTCOMES

CO1:	Demonstrate the dismantling of engine components and cleaning	**K4**
CO2:	List the minor and major reconditioning of various engine components	**K3**
CO3:	Illustrate the maintenance and servicing of suspension systems	**K3**
CO4:	Analyze the testing methods for checking the battery, starter motor,charging systems, ignitions system	**K3**
CO5:	Discuss the fault diagnosis and maintenance of modern electroniccontrols	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	3	1	-	-	-	-	-	-	-	3	2
CO 2	2	1	1	2	3	-	-	-	-	-	-	-	2	1
CO 3	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO 4	1	1	1	1	3	-	-	-	-	-	-	-	1	1
CO 5	1	1	2	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
✓	✓		✓		✓

21MAPE13	SIMULATION OF VEHICLE SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

The objective of this course is to introduce the essential principles of simulation of various vehicle systems like longitudinal, lateral dynamics, modeling of suspension and tire system etc.

UNIT I LONGITUDINAL DYNAMICS AND CONTROL 12

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

UNIT II LATERAL DYNAMICS AND ELECTRONIC STABILITY CONTROL 12

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

UNIT III MODELING OF PASSIVE AUTOMOTIVE SUSPENSIONS 12

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

UNIT IV MODELING OF SEMIACTIVE AND ACTIVE AUTOMOTIVE SUSPENSIONS 12

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

UNIT V LATERAL AND LONGITUDINAL TIRE FORCES 12

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

TOTAL: 60 Hours

TEXT BOOKS/ REFERENCES:

1. Rajesh Rajamani, “Vehicle Dynamics and Control”, Springer, 2006.
2. Wei Liu , “Introduction to Hybrid Vehicle System Modeling and Control”, John Wiley & Sons, 2013.

COURSE OUTCOMES

CO1:	Distinguish the longitudinal dynamics and control	**K3**
CO2:	Organize the lateral dynamics and electronic stability control	**K4**
CO3:	Create knowledge on modeling of passive automotive suspensions	**K3**
CO4:	Evaluate the modeling of semi-active and active automotive suspensions	**K3**
CO5:	Analyze the knowledge on lateral and longitudinal tire forces	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 3	2	2	2	3	1	-	-	-	-	-	-	-	2	2
CO 4	2	1	1	2	2	-	-	-	-	-	-	-	2	1
CO 5	3	2	1	1	2	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE14	AUTOMOTIVE AERODYNAMICS	L T P C 3 1 0 4

COURSE OBJECTIVE:
To study the various aerodynamic aspects Car body details, vehicle aerodynamics wind tunnels – Vehicle Handling

UNIT I INTRODUCTION **12**

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

UNIT II AERODYNAMIC DRAG OF CABS **12**
Car as a bluff body – Flow field around car – drag force – types of drag force – analysis of aerodynamic drag – drag coefficient of cars – strategies for aerodynamic development – low drag profiles.

UNIT III SHAPE OPTIMIZATION OF CABS **12**
Front and modification – front and rear wind shield angle – Boat tailing – Hatch back, fast back and square back – Dust flow patterns at the rear – Effect of gap configuration – effect of fasteners.

UNIT IV VEHICLE HANDLING **12**
The origin of force and moments on a vehicle – side wind problems – methods to calculate forces and moments – vehicle dynamics under side winds – the effects of forces and moments – Characteristics of forces and moments – Dirt accumulation on the vehicle – wind noise – drag reduction in commercial vehicles.

UNIT V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS **12**
Introduction – Principles of wind tunnel technology – Limitation of simulation – Stress with scale models – full scale wind tunnels – measurement techniques – Equipment and transducers – road testing methods – Numerical methods.

TOTAL: 60 Hours

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

REFERENCES:

1. A. Pope, Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1994.
2. Automotive Aerodynamics: Update SP-706, SAE, 1987.
3. Vehicle Aerodynamics, SP-1145, SAE, 1996.

COURSE OUTCOMES:

CO1:	Evaluate basic fluid theory.	**K3**
CO2:	Demonstrate knowledge and understanding of aerodynamics in theautomotive field.	**K3**
CO3:	Explain the principles and functions of wind tunnels.	**K4**
CO4:	Conceptual understanding of mathematics, numerical analysis, statistics, andcomputer and information.	**K5**
CO5:	Application of established engineering methods to complex engineeringproblem solving.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 3	2	2	2	1	1	-	-	-	-	-	-	-	2	2
CO 4	3	1	1	2	2	-	-	-	-	-	-	-	3	1
CO 5	2	2	1	3	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE15	AUTOMOTIVE SAFETY	L T P C 3 1 0 4

COURSE OBJECTIVE:

The Main objective of this course is to provide the wider knowledge of safety concepts, safety equipments comfort and convenience system of automotive system.

UNIT I INTRODUCTION **12**

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

UNIT II SAFETY CONCEPTS **12**

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

UNIT III SAFETY EQUIPMENTS **12**

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

UNIT IV COLLISION WARNING AND AVOIDANCE **12**

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

UNIT V COMFORT AND CONVENIENCE SYSTEM **12**

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

TOTAL: 60 Hours

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES:

CO1:	Familiar with the concepts of safety.	**K3**
CO2:	Describe the various safety equipment's.	**K3**
CO3:	Describe the electronic system for activating air bags.	**K4**
CO4:	Familiar with the various Collision warning system.	**K5**
CO5:	Explain the object detection system with braking system interactions.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO 2	2	1	1	2	1	-	-	-	-	-	-	-	2	1
CO 3	2	2	1	1	2	-	-	-	-	-	-	-	2	2
CO 4	1	2	1	2	1	-	-	-	-	-	-	-	1	2
CO 5	2	2	1	2	1	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE16	TRANSPORT MANAGEMENT	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION **12**

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 **12**

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 **12**

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 **12**

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 **12**

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: 60 Hours

TEXT BOOKS/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

COURSE OUTCOMES:

CO1:	Describe the functions of Personnel Management and their relevance to theorganization.	**K3**
CO2:	Justify the Employment tests, training procedure and psychological tests.	**K3**
CO3:	Illustrate the principal function of administrative, traffic, secretarial andengineering divisions.	**K4**
CO4:	Describe the responsibility in forms of state, municipality, public and privateundertakings.	**K5**
CO5:	State the principal features of operating costs for transport vehicles.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	1	1	3	2	-	-	-	-	-	-	-	2	1
CO 3	1	2	2	2	1	-	-	-	-	-	-	-	1	2
CO 4	2	1	1	1	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	2	1	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End SemesterExams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		✓

21MAPE17	AUTOMOTIVE ELECTRICAL TECHNOLOGY	L	T	P	C
		3	1	0	4

COURSE 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 12

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 12

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 12

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 SYSTEMS 12

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 12

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: 60 Hours

TEXTBOOKS / REFERENCES:

1. Robert Bosch ,Alternators and Starter Motors, GmbH, 2003.
2. Robert Bosch ,Ignition Systems for Gasoline Engines, Bosch GmbH, 2003.
3. Robert Bosch , Motor-Vehicle Batteries and Electrical Systems, GmbH, 2003.

4. AL Santini , Automotive Technology- Electricity and Electronics, Cengage Learning India Pvt Ltd., 2011
5. W. H. Crouse, Automobile Electrical Equipment, McGraw Hill Book Co Inc.NewYork,2005
6. A. W. Judge, Modern Electrical Equipments of Automobiles, Chapman & Hall, London 2004.
7. P.L. Kholi, Automotive Electrical Equipment, Tata McGraw-Hill Education Pvt. Ltd., 2004
8. Robert Bosch, Automotive Handbook, Bently Publishers,2004

COURSE OUTCOMES

CO1:	Acquire the knowledge of Electrical and Electronics engineering concepts	**K3**
CO2:	Understand the purpose, construction and working of differentbatteries and electrical systems used in Automobiles	**K3**
CO3:	Identify, demonstrate and compare the various components andsystems of Auto electrical systems	**K4**
CO4:	Obtain an overview of automotive components, subsystems,design cycles, communication protocols	**K3**
CO5:	Reproduce knowledge on wiring, lighting and other instruments	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	3	1	1	1	-	-	-	-	-	-	-	2	3
CO 3	2	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 4	3	2	1	2	1	-	-	-	-	-	-	-	3	2
CO 5	3	2	2	2	1	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
✓	✓		✓		✓

21MAPE18	IC ENGINE PROCESS MODELING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To understand the procedure for modeling the various IC engine process

UNIT I INTRODUCTION 12

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 12

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 12

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 12

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 12

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 : 60 Hours

COURSE OUTCOME:

CO-1: Revise the processes involved in engine cycles.
CO-2: Evaluate with the combustion and stoichiometry.
CO-3: Implement the computer simulation of SI engine with fuel air cycle
CO-4: Compare the modeling of progressive combustion and gas exchange processes
CO-5: Examine the calculation of engine performance, combustion and emission characteristics.

TEXT BOOKS/REFERENCES

1. V.Ganesan, Computer Simulation of Compression ignition engine process, Universities Press (I) Ltd, Hyderbad, 2000.
2. V.Ganesan, Computer Simulation of spark ignition engine process, Universities Press (I) Ltd, Hyderbad, 1996.
3. John. B. Heywood, Internal Combustion Engines, Tata McGraw Hill Co., Newyork, 1988.

COURSE OUTCOMES

CO1:	Revise the processes involved in engine cycles.	**K3**
CO2:	Evaluate with the combustion and stoichiometry.	**K4**
CO3:	Implement the computer simulation of SI engine with fuel air cycle	**K3**
CO4:	Compare the modeling of progressive combustion and gas exchange processes	**K3**
CO5:	Examine the calculation of engine performance, combustion and emission characteristics.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 3	2	2	2	3	1	-	-	-	-	-	-	-	2	2
CO 4	2	1	1	2	2	-	-	-	-	-	-	-	2	1
CO 5	3	2	1	1	2	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE19	MATERIALS IN AUTOMOTIVE TECHNOLOGY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To make the students to understand the requirements related to materials used in various automotive parts

UNIT I INTRODUCTION 12

Elasticity-forms - Stress and strain relationship in engineering materials - Deformation mechanism - Strengthening material - Strain hardening, alloying, polyphase mixture, martensitic precipitation, dispersion, fiber and texture strengthening - iron carbon diagram.

UNIT II METALLIC MATERIALS 12

Cast irons - types, properties, structures, compositions and applications, plain carbon steels, low alloy steels and effects of alloying elements, high alloy steels, stainless steel types, castability, formability, machinability, hardenability and weldability of the material, high temperature steels and super alloys. Decorative and functional coating materials for automotive parts - Electro less Nickel, Hard Chrome, and, Zirconium Phosphate, Zinc flake, Metal oxides.

UNIT III COMPOSITES 12

Mechanics, Manufacturing and Design. Types of composites. Fiber reinforced plastics (FRP), engineering ceramics, metal matrix composites, silicon carbide, graphite, fibers of zirconia, alumina and boron nitride - metal filaments - boron filaments - glass fibers applications, nanocomposites. Piezoelectric composites.

UNIT IV ELECTRICAL AND MAGNETIC MATERIALS 12

Semiconductors materials, single crystals, soft and hard magnets, superconductors, MEMS materials, nano materials, smart materials, shape memory alloys. Piezoelectric Materials., piezoceramic materials, poly vinylidene fluoride, Magneto strictive Materials. Metamaterials.

UNIT V RUBBER AND PLASTICS MATERIALS 12

Plastics / rubber components in automobiles – function – selection criteria. Structure – property relationship of rubber. Rubber mounts – spring design – comparison with metallic springs – shape factor and its effect. Typical mounts, compounding and manufacture. Seals for static and dynamic applications. Brake fluid / hydraulic hoses, materials and manufacture.

TOTAL: 60 Hours

TEXT BOOK:

1. Michael F. Ashby, Materials Selection in Mechanical Design, Butterworth Heinemann, 2005.
2. C.Daniel Yesudian, Materials Science and Metallurgy, Scitech Publications (India), 2004.

REFERENCES:

1. I.J.Polmear, “Light Alloys”, Arnold Publishers, 1995.
2. D.Swarup and M.N. Saxena, "Elements of Metallurgy", Rastogi Publishers, Meerut, 1994.

3. N.K. Srinivasan and S.S.Ramakrishnan, "The Science of Engineering Materials", Oxford and IBH Pub. Co., New Delhi, 1993.
4. L.H. Van Vlack, "Elements of Materials Science and Engineering", Addison Wesley, New York, 1991.
5. A.G.Guy," Elements of Physical Metallurgy", Oxford & IBH Pub. Co., 1990.

COURSE OUTCOMES:

CO1:	Select the materials used in specific parts	**K3**
CO2:	Judge the metallic materials for a part	**K3**
CO3:	Examine the composite materials used in specific parts	**K4**
CO4:	Identify the magnetic and plastic materials for a part	**K5**
CO5:	List the requirements of functional coatings	**K3**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	3	3	3	3	2	2
CO2	3	3	2	3	-	-	-	-	2	2	2	2	3	2
CO3	3	2	2	2	-	-	-	-	2	2	2	2	2	2
CO4	3	2	3	3	-	-	-	-	3	2	2	3	3	3
CO5	3	3	3	3	-	-	-	-	3	2	3	2	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

21MAPE20	MODELING OF VEHICLE SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

The objective of this course is to introduce the essential principles of simulation of various vehicle systems like longitudinal, lateral dynamics, modeling of suspension and tyre system,etc.

UNIT I LONGITUDINAL DYNAMICS AND CONTROL 12

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

UNIT II LATERAL DYNAMICS AND ELECTRONIC STABILITY CONTROL 12

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

UNIT III MODELING OF PASSIVE AUTOMOTIVE SUSPENSIONS 12

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

UNIT IV MODELING OF SEMIACTIVE AND ACTIVE AUTOMOTIVE SUSPENSIONS 12

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

UNIT V LATERAL AND LONGITUDINAL TYRE FORCES 12

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

TOTAL: 60 Hours

TEXT BOOK

1. Rajesh Rajamani , "Vehicle Dynamics and Control", Springer, 2006.
2. Reza N.Jazar , "Vehicle Dynamics: Theory and Applications", Springer, 2008.

COURSE OUTCOMES

CO1:	Evaluate the longitudinal and lateral dynamics	**K3**
CO2:	Examine the electronic stability control	**K4**
CO3:	Implement with passive suspension model	**K3**
CO4:	Classify the semi-active and active suspension model	**K3**
CO5:	Explain the lateral and longitudinal tyre forces	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 3	2	2	2	3	1	-	-	-	-	-	-	-	2	2
CO 4	2	1	1	2	2	-	-	-	-	-	-	-	2	1
CO 5	3	2	1	1	2	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE21	FINITE ELEMENT METHODS IN AUTOMOBILE	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

The objective of this course is to understand how to use finite element analysis in engineering problems and automotive applications

UNIT I INTRODUCTION 12

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 12

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 12

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 12

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 12

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: 60 Hours

TEXT BOOK:

1. L.J. Segerlind, Applied Finite Element Analysis, Second Edition, John Wiley and Sons Inc., New York, 1984

2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and applications of finite element analysis”, 4th edition, John Wiley & Sons, 2007.

REFERENCES

1. C.S. Krishnamurthy, Finite Element Analysis, Tata McGraw Hill, 1987.

2. V. Ramamurthi, Computer Aided Design in Mechanical Engineering, Tata McGraw Hill,

COURSE OUTCOMES

CO1:	Familiarize the basic concept of finite element methods	**K4**
CO2:	Acquire the knowledge on one-dimensional problems	**K3**
CO3:	Acquire the knowledge on two-dimensional continuum	**K3**
CO4:	Develop the skill on approaching the Heat transfer and fluidflow problems	**K4**
CO5:	Gain knowledge on application of finite element method inAutomobiles	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO 1	3	3	3	2	3	-	-	-	-	-	-	-	3	3
CO 2	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO 3	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO 4	3	3	2	3	2	-	-	-	-	-	-	-	3	3
CO 5	2	1	2	2	1	-	-	-	-	-	-	-	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE23	ELECTRONICS IN ENGINE MANAGEMENT SYSTEM	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

The course will focus on electronics in engine management discuss the fundamentals of engine control, sensors, actuators, electronics systems, and diagnostics system.

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 12

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 12

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 12

Layout and working of SI engine management systems. Group and sequential injection techniques. Advantages of electronic ignition systems. Types of solid state ignition systemsand their principle of operation, Contactless (BREAKERLESS) electronic ignition system, Electronic spark timing control.

UNIT IV CI ENGINE MANAGEMENT 12

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 12

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: 60 Hours

TEXT BOOKS:

1. William B Ribbens , Understanding Automotive Electronics, SAE 1998

2. Eric Chowanietz , Automobile Electronics , SAE International, 1995

REFERENCES:

1. Robert Bosch, Diesel Engine Management, SAE Publications, 3rd Edition, 2004

2. Robert Bosch, Gasoline Engine Management, SAE Publications, 2nd Edition, 2004

COURSE OUTCOMES:

CO1:	Revise the fundamentals and operations in engine management systems.	**K3**
CO2:	Compare the function of various sensors and actuators.	**K3**
CO3:	Implement with the various fuel injection systems pertain to SI and CI Engine.	**K4**
CO4:	Explain the control algorithm during various engine operating conditions.	**K5**
CO5:	Summarize the digital engine control systems	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	1	1	1	1	3	2	2	-	-	-	-	-	1	1
CO 2	2	2	2	2	1	-	1	-	-	-	-	-	2	2
CO 3	2	1	1	2	3	-	1	-	-	-	-	-	2	1
CO 4	1	3	2	1	1	2	1	-	-	-	-	-	1	3
CO 5	2	2	2	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAPE22	THEORY OF FUELS AND LUBRICANTS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

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 12

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

UNIT II THEORY OF LUBRICATION 12

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 LUBRICANTS 12

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

UNIT IV PROPERTIES AND TESTING OF FUELS 12

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

UNIT V COMBUSTION & FUEL RATING 12

SI Engines – flame propagation and mechanism of combustion, normal combustion, knocking, octane rating, fuel requirements. CI Engine, mechanism of combustion, diesel knock, cetane rating, fuel requirements. Additive - mechanism, requirements of an additive, petrol fuel additives and diesel fuel additives – specifications of fuels

TOTAL: 60 Hours

TEXT BOOKS:

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

REFERENCES:

1. J.S.S. Brame, and J.G. King, – "Fuels Solids, Liquids, Gaseous". Edward Arnold, 1961
2. W.Francis, "Fuels and Fuel Technology", Vol. I & II, Pergamon, 1965
3. G.D. Hobson, & W. Pohl, "Modern Petroleum Technology", 1974
4. A.R., Lansdown, Lubrication, "A practical guide to lubricant selection", Pergamon press, 1982.
5. Raymond. C. Gunther, "Lubrication", Chilton Book Co., 1971.

COURSE OUTCOMES

CO1:	Explain the distillation process, additives for fuels and characteristics of fuels	K3
CO2:	Discuss the need and performance characteristics of alternative liquid fuels for both SI and CI engines	K3
CO3:	Describe the need and performance characteristics of alternative gaseous fuels for both SI and CI engines	K4
CO4:	Calculate and analyze A/F ratio for the engine operating conditions and also can estimate quantitatively the exhaust gas constituents	K5
CO5:	Explain the need for lubricants, factors influencing the engine lubrication and testing of fuels	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	1	-	-	-	-	-	-	-	3	3
CO 2	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO 3	1	2	1	2	1	-	-	-	-	-	-	-	1	2
CO 4	2	1	2	1	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

21MAPE24	QUALITY CONTROL PROCESS AND RELIABILITY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To be familiar with the various quality control techniques and control charts for variables and attributes

UNIT I PROCESS CONTROL FOR VARIABLES 12

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality Cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for chart -process capability – process capability studies. variables – X chart, R chart and simple problems, Six sigma concepts.

UNIT II PROCESS CONTROL FOR ATTRIBUTES 12

Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III ACCEPTANCE SAMPLING 12

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV LIFE TESTING – RELIABILITY 12

Life testing – Objective – failure data analysis, Mean failure rate, means time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability –simple problems, Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABLITY 12

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

TOTAL: 60 Hours

TEXT BOOKS:

1. Douglas.C.Montgomery, "Introduction to Statistical quality control", John wiley, 4th edition2001.
2. L.S. Srinath, "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES:

1. John.S.Oakland. Statistical process control", Elsevier, 5th edition, 2005
3. Monohar Mahajan, "Statistical Quality Control", DhanpatRai& Sons, 2001.
4. R.C. Gupta, "Statistical Quality control", Khanna Publishers, 1997.

5. D.H. Besterfield, “Quality Control”, Prentice Hall, 1993.

COURSE OUTCOMES:

CO1:	Define quality, concepts of quality and TQM	**K3**
CO2:	Explain in detail about the TQM principles	**K3**
CO3:	Describe the various tools and techniques of TQM	**K4**
CO4:	Define quality circle and performance measures	**K5**
CO5:	List the quality systems implemented in manufacturing and service sectorsincluding IT.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	3	1	1	1	-	-	-	-	-	-	-	2	3
CO 3	2	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 4	3	2	1	2	1	-	-	-	-	-	-	-	3	2
CO 5	3	2	2	2	1	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAGE01	HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

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

UNIT I INTRODUCTION **12**

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

UNIT II PNEUMATIC SYSTEMS **12**

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

UNIT III HYDRAULIC SYSTEMS **12**

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

UNIT IV ADVANCED TOPICS IN HYDRAULICS AND PNEUMATICS **12**

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

UNIT V AUTOMOTIVE APPLICATIONS **12**

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

TOTAL: 60 Hours

TEXT BOOKS/ REFERENCES:

1. Anthony Espisito, “Fluid Power with Application”, Pearson Education (Singapore) Pte.Ltd, Delhi, India, Fifth Edition, First Indian Reprint, 2003.
2. S.R. Majumdar, “Oil Hydraulic Systems: Principles and Maintenance”, Tata McGraw- Hill Publishing Company Ltd., New Delhi, Fourth Reprint, 2003.
3. KG. Festo, “Pneumatic Tips”, Festo, Germany, 1987.
4. Andrew Parr, “Hydraulic and Pneumatics”, Jaico publishing house, 1999.

COURSE OUTCOMES:

CO1:	Describe the fundamental theoretical concepts governing fluid power	**K3**
CO2:	Ability to formulate the mathematical models of hydraulic and pneumaticcircuits.	**K3**
CO3:	Identify the common hydraulic and pneumatic components	**K4**
CO4:	Describe the working principle of pneumatic cylinders and motors.	**K5**
CO5:	Analyze the pneumatic circuits by considering the possible failures.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO 1	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO 2	3	3	1	2	3	-	-	-	-	-	-	-	3	3
CO 3	2	1	2	3	2	-	-	-	-	-	-	-	2	1
CO 4	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO 5	1	1	1	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

21MAGE02	TOTAL QUALITY SYSTEM AND ENGINEERING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

At the end of this course the student would be able to apply the various TQM tools and techniques of quality management to manufacturing and services processes.

UNIT I INTRODUCTION **12**

Principles of Quality Management - Pioneers of TQM - Quality costs – Customer Orientation - Benchmarking - Re-engineering - Concurrent Engineering.

UNIT II PRACTICES OF TQM **12**

Quality system - ISO 9001:2000 - QS 9000, ISO 14000 - Quality Auditing - Leadership - Organizational Structure - Team Building - Information Systems and Documentation.

UNIT III TECHNIQUES OF TQM **12**

Single Vendor Concept - J.I.T. - Quality Function deployment - Quality Circles - KAIZEN - SGA - POKA YOKE - Taguchi Methods.

UNIT IV QUALITY BY DESIGN **12**

Introduction – Rationale for implementation – Benefits– Teams – Communication models Implementation – Tools – Misconceptions and Pitfalls.

UNIT V PRODUCTS LIABILITY **12**

Introduction – Product safety law – products liability law – defenses – Proof and the expert witness – Financial Loss – The future of products liability – Prevention.

TOTAL: 60 Hours

TEXTBOOKS / REFERENCES:

1. Harvid Noori and Russel, “Production and Operations management - Total Quality and Responsiveness ", McGraw-Hill Inc, 1995.
2. Suresh Dalela and Saurabh, ISO 9000 " A Manual for Total Quality Management" S.Chand and Company Ltd., 1997.
3. John Bank, “The Essence of Total Quality Management", Prentice Hall of India Pvt.Ltd., 1995.
4. Mohamed Zairi, “Total Quality Management for Engineers “, Woodhead PublishingLimited 1991.
5. D.H. Besterfield, C.M. Besterfield, G.H. Besterfield and M.S.Besterfield, “Total Quality Management ", Pearson Education, 2002.

COURSE OUTCOMES:

CO1:	Define quality, concepts of quality and TQM	**K3**
CO2:	Explain in detail about the TQM principles	**K3**
CO3:	Describe the various tools and techniques of TQM	**K4**
CO4:	Define quality circle and performance measures	**K5**
CO5:	List the quality systems implemented in manufacturing and service sectorsincluding IT.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	3	1	1	1	-	-	-	-	-	-	-	2	3
CO 3	2	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 4	3	2	1	2	1	-	-	-	-	-	-	-	3	2
CO 5	3	2	2	2	1	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAGE03	ROBOTICS AND SENSORS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To understand the functions of the basic components of a Robot and the use of various types of End of Effectors and Sensors

UNIT I INTRODUCTION **12**

An Introduction to sensors and Transducers, History and definitions, Smart Sensing, AI sensing, Need of sensors in Robotics.

UNIT II SENSORS IN ROBOTICS **12**

Position sensors - optical, non-optical, Velocity sensors, Accelerometers, Proximity Sensors - Contact, non-contact, Range Sensing, touch and Slip Sensors, Force and Torque Sensors

UNIT III MISCELLANEOUS SENSORS IN ROBOTICS **12**

Different sensing variables - smell, Heat or Temperature, Humidity, Light, Speech or Voice recognition Systems, Telepresence and related technologies.

UNIT IV VISION SENSORS IN ROBTICS **12**

Robot Control through Vision sensors, Robot vision locating position, Robot guidance with vision system, End effector camera Sensor.

UNIT V MULTISENSOR CONTROLLED ROBOT ASSEMBLY **12**

Control Computer, Vision Sensor modules, Software Structure, Vision Sensor software, Robot programming, Handling, Gripper and Gripping methods, accuracy - A Case study.

TOTAL: 60 Hours

COURSE OUTCOME:

CO-1: Review the robotics and sensors

CO-2: Justify the sensors in robotics

CO-3: Identify the miscellaneous sensors in robotics

CO-4: Develop the vision sensors in robotics

CO-5: Explain the multi-sensor-controlled robot assembly

TEXTBOOKS /REFERENCES:

1. Paul W Chapman, "Smart Sensors", an Independent Learning Module Series, 1996
2. Richard D. Klafer, Thomas a. Chmielewski; Michael Negin, "Robotic Engineering - An integrated approach", Prentice Hall of India Private Limited, 1989
3. John Iovice, "Robots, Androids and Animalrons", Mc Graw Hill, 1998
4. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, "Robotics - Control Sensing, Vision and Intelligence", Mc Graw Hill Internation Editions, 1987
5. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G. Odrey, "Industrial Robotics - Technology, Programming and Applications", Mc Graw Hill, International Editions, 1986
6. Sabric Soloman, "Sensors and Control Systems in Manufacturing", Mc Graw Hill, International Editions, 1994.

COURSE OUTCOMES:

CO1:	Review the robotics and sensors	**K3**
CO2:	Justify the sensors in robotics	**K3**
CO3:	Identify the miscellaneous sensors in robotics	**K4**
CO4:	Develop the vision sensors in robotics	**K5**
CO5:	Explain the multi-sensor-controlled robot assembly	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO 1	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO 2	3	3	1	2	3	-	-	-	-	-	-	-	3	3
CO 3	2	1	2	3	2	-	-	-	-	-	-	-	2	1
CO 4	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO 5	1	1	1	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

21MAGE04	MECHATRONICS IN MANUFACTURING SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

UNIT I INTRODUCTION **12**

Introduction to Mechatronics - Systems- Need for Mechatronics - Emerging area of Mechatronics - Classification of Mechatronics - Measurement Systems – Control Systems.

UNIT II SENSORS AND TRANSDUCERS **12**

Introduction - Performance Terminology – Potentiometers - LVDT – Capacitance sensors - Strain gauges - Eddy current sensor - Hall Effect sensor – Temperature sensors - Light sensors - Selection of sensors - Signal processing.

UNIT III ACTUATORS **12**

Actuators – Mechanical - Electrical - Fluid Power - Piezoelectric – Magneto strictive - Shape memory alloy - applications - selection of actuators.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS **12**

Introduction - Basic structure - Input and output processing - Programming - Mnemonics-Timers, counters and internal relays - Data handling - Selection of PLC.

UNIT V DESIGN AND MECHATRONICS CASE STUDIES **12**

Designing - Possible design solutions-Traditional and Mechatronics design concepts - Case studies of Mechatronics systems - Pick and place Robot - Conveyor based material handling system - PC based CNC drilling machine – Mechatronics Control in automated Manufacturing – Data Acquisition Case studies.

TOTAL: 60 Hours

COURSE OUTCOME:

CO-1: Build the mechatronics for manufacturing systems

CO-2: Review the sensors and transducers

CO-3: Review the actuators and its selection

CO-4: Implement the programmable logic controllers

CO-5: Describe the design and mechatronics case studies

TEXTBOOKS / REFERENCES:

1. W.Bolton, “Mechatronics”, Pearson education, second edition, fifth Indian Reprint,2003
2. A.Smaili and F.Mrad, "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008
3. Devadas Shetty and Richard A.Kolk, “Mechatronics systems design”, PWS Publishing company, 2007
4. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006
5. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and applicatlions” Tata McGraw-Hill Publishing Company Limited, 2003

COURSE OUTCOMES:

CO1:	Build the mechatronics for manufacturing systems	**K3**
CO2:	Review the sensors and transducers	**K3**
CO3:	Review the actuators and its selection	**K4**
CO4:	Implement the programmable logic controllers	**K5**
CO5:	Describe the design and mechatronics case studies	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO 1	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO 2	3	3	1	2	3	-	-	-	-	-	-	-	3	3
CO 3	2	1	2	3	2	-	-	-	-	-	-	-	2	1
CO 4	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO 5	1	1	1	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

21MAGE05	RAPID PROTOTYPING AND TOOLING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields

UNIT I INTRODUCTION 12

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping and Tooling on Product Development – Benefits- Applications – Digital prototyping - Virtual prototyping.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 12

Stereo lithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, three dimensional printing: Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS 12

Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.

UNIT IV REVERSE ENGINEERINGANDCAD MODELING 12

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

UNIT V RAPID TOOLING 12

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronic industries.

Total: 60 Hours

TEXTBOOKS / REFERENCES:

1. Andreas Gebhardt, Rapid prototyping, Hanser Gardener Publications, 2003
2. Liou W.Liou, Frank W.Liou, Rapid Prototyping and Engineering applications : A tool box for prototype development, CRC Press, 2007
3. Ali K. Kamrani, Emad Abouel Nasr, Rapid Prototyping: Theory and practice, , Springer, 2006

COURSE OUTCOMES:

CO1:	Design the rapid prototyping and tooling	**K3**
CO2:	Review the liquid based and solid based rapid prototyping systems	**K3**
CO3:	Examine the powder based rapid prototyping systems	**K4**
CO4:	Use the reverse engineering and cad modeling	**K5**
CO5:	Summarize the knowledge on rapid tooling	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	3	1	1	1	-	-	-	-	-	-	-	2	3
CO 3	2	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 4	3	2	1	2	1	-	-	-	-	-	-	-	3	2
CO 5	3	2	2	2	1	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAMC01	RESEARCH METHODOLOGY AND IPR	L T P C 2 0 0 2

COURSE OBJECTIVE:

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

UNIT I INTRODUCTION TO RESEARCH 6

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 6

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 6

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 I V RESEARCH REPORT 6

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.

UNIT V PRINCIPLES OF IPR, COPYRIGHT LAW AND PRACTICES 6

Introduction to Intellectual Property Rights, Concept and Theories Kinds of Intellectual Property Rights, Economic analysis of Intellectual Property Rights, Advantages and Disadvantages of IPR, Copyright and Neighboring Rights, Concept and Principles, Historical background and Development of Copyright Law, Leading International Instruments, Berne Convention, Universal Copyright Convention

Total: 30 Hours

TEXT BOOKS/ REFERENCES

1. C.R.Kothari, Research Methodology, Wishva Prakashan, New Delhi, 2001
2. Donald H.McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002
3. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property Eastern Book Company, Lucknow, 2009

COURSE OUTCOMES:

CO1:	Propose to formulate research problem	**K3**
CO2:	Select to carry out research analysis	**K3**
CO3:	Classify to follow data collection methods	**K4**
CO4:	Implement to understand multivariate statistical techniques	**K5**
CO5:	Represent to understand about research report.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	3	1	1	1	-	-	-	-	-	-	-	2	3
CO 3	2	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 4	3	2	1	2	1	-	-	-	-	-	-	-	3	2
CO 5	3	2	2	2	1	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration /Presentation	Open book test
			✓		✓

21MAAC01	TECHNICAL SEMINAR - I	L T C P 0 0 0 0

COURSE OBJECTIVE:

Students should present the specific topics assigned by the department through the power point presentation by collecting information/details from various academic, relevant industry and open sources.

21MAAC02	TECHNICAL SEMINAR - II	L T C P 0 0 0 0

COURSE OBJECTIVE:

Students should present the specific topics assigned by the department through the power point presentation by collecting information/details from various academic, relevant industry and open sources.

21MAIT01	INTERNSHIP	L T P C 0 0 4 2

COURSE OBJECTIVE:

The objective of the in-plant training is to enhance and improve the skill set and knowledge of the automobile engineering students which boost their performance and consequently helping them to meet their career objectives. Training helps learners to acquire the latest techniques, skills, methodologies and to build a strong foundation for their career growth. Three periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the faculty. The student has to undergo a training of 10 to 12 days during the semester in the automotive related industries and submit a detailed report based on the industry, products and services, things learned from the industry. This final report shallbe typewritten form as specified in the guidelines

21MAPR01	PROJECT DISSERTATION - I	L	T	P	C
		0	0	20	10

COURSE OBJECTIVE:

The objective of the project work is to enable the Student who individually carryout the project. This Project which involves theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines. The continuous assessment shall be made as prescribed by the regulation.

21MAPR02	PROJECT DISSERTATION - II	L	T	P	C
		0	0	32	16

OBJECTIVE:

The objective of the project work is to do a project individually which involves theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines.

The continuous assessment shall be made as prescribed by the regulation.