DEPARTMENT OF AUTOMOBILE ENGINEERING
ANNA UNIVERSITY, CHENNAI

VISION OF THE DEPARTMENT

"To be a premier department in **Automobile Engineering** and reach the **highest academic level** in the field of **Automobile Engineering** by **imparting knowledge**, continuously **enhancing Research & Development** activities, supporting industries through **consultancy programme** and providing the nation with **high quality engineers**"

MISSION OF THE DEPARTMENT

1. To prepare students **excel in their chosen professions** by offering **high quality education** in **automobile engineering** with fundamental knowledge, interdisciplinary problem-solving skills and **confidence** required.

2. To provide **supportive** and **diverse environment** that encourage students to achieve the **best of their abilities** to be **innovators** or **job providers**.

3. To maintain **constant and active partnership** with industries for **technology development** and **transfer** through consultancy projects.

Attested

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ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.E. AUTOMOBILE ENGINEERING (R-2023)
REGULATIONS 2023
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I.	**Professional Excellence:** Graduates will demonstrate expertise in the field of Automobile Engineering, applying advanced knowledge and skills to design, analyze, and optimize automotive systems and components. They will exhibit a strong understanding of industry practices, emerging technologies, and sustainable solutions.
II.	**Leadership and Innovation:** Graduates will exhibit leadership qualities, demonstrating the ability to effectively lead teams, manage projects, and drive innovation in the automotive industry. They will be capable of identifying and addressing complex engineering challenges, developing creative and sustainable solutions, and adapting to evolving technological advancements.
III.	**Ethical and Social Responsibility:** Graduates will uphold high ethical standards and exhibit a strong sense of social responsibility. They will prioritize safety, environmental considerations, and ethical practices in the design, development, and operation of automobile systems. They will contribute to the betterment of society by addressing societal needs and advancing sustainable and responsible practices in the automotive field.

2. PROGRAMME OUTCOMES(POs):

PO	Programme Outcomes
1	An ability to independently carry out research/investigation and development work to solve practical problems
2	An ability to write and present a substantial technical report/document
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4	Foster the preparedness of postgraduates at local, regional, and global levels to excel in various career paths, including government services, research and development organizations, corporate sectors, academic institutes, and industries.
5	Cultivate the ability of postgraduates to function effectively both as independent contributors and as team members within a multidisciplinary setting.
6	Nurture postgraduates to become engineering solution providers, addressing the nation's environmental, societal, and economic challenges.

3. PEO/PO Mapping:

PEO	POs					
	1	**2**	**3**	**4**	**5**	**6**
I.	3	3	3	3	3	3
II.	3	3	3	3	3	3
III.	3	3	3	3	3	3

1,2,3, -, scale against the correlation PO's with PEO's

4. PROGRAM SPECIFIC OUTCOMES (PSOS):

1. Apply advanced engineering principles, state-of-the-art tools, and software to design, analyze, and optimize automotive systems and components.
2. Develop innovative and sustainable solutions to address complex challenges in the field of Automobile Engineering, considering safety, environmental, and ethical considerations.
3. Demonstrate effective communication, teamwork, and leadership skills while staying updated with the latest advancements in automobile technology, fostering a commitment to lifelong learning and professional development.

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PROGRAM ARTICULATION MATRIX

		Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
YEAR I	Sem 1	Advanced Numerical Methods	3	3	3	3	2	2	-	-	-
		Automotive Chassis	3	2	2	3	3	3	3	3	2
		Automotive Transmission	3	2	2	2	2	2	3	3	2
		Engine and Auxiliary Systems	3	3	3	3	3	3	3	3	2
		Vehicle Design cum Laboratory	3	3	3	3	3	3	3	3	2
		Research Methodology and IPR	3	3	2	-	-	-	-	-	-
		Engine and Chassis Components Laboratory	3	2	2	3	3	3	3	3	2
	Sem 2	Automotive Pollution and Control	3	3	3	3	3	3	3	3	2
		Dynamics of Road Vehicles	3	3	3	3	3	3	3	3	2
		Vehicle Body Engineering and Ergonomics	3	2	2	2	2	2	3	3	2
		Vehicle Electrical and Electronics System cum Laboratory	3	3	3	3	3	3	3	3	2
		Vehicle Management Systems	3	3	3	3	3	3	3	3	2
		Engine and Vehicle Testing Laboratory	3	2	2	3	3	3	3	3	2
		Technical Seminar	3	3	3	3	3	3	3	3	3
YEAR II	Sem 3	Electric and Hybrid Vehicles	3	3	3	3	3	3	3	3	2
		Project Work I	3	3	3	3	3	3	3	3	3
	Sem 4	Project Work II	3	3	3	3	3	3	3	3	3

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M.E. AUTOMOBILE ENGINEERING
REGULATIONS 2023
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTER CURRICULUM AND SYLLABI
SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MA3155	Advanced Numerical Methods	FC	4	0	0	4	4
2	AM3101	Automotive Chassis	PCC	3	1	0	4	4
3	AM3102	Automotive Transmission	PCC	3	0	0	3	3
4	AM3103	Engine and Auxiliary Systems	PCC	3	0	0	3	3
5	AM3104	Vehicle Design cum Laboratory	PCC	3	0	3	6	4.5
6	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
PRACTICAL								
7	AM3111	Engine and Chassis Components Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**18**	**2**	**6**	**26**	**23**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AM3201	Automotive Pollution and Control	PCC	3	0	0	3	3
2.	AM3202	Dynamics of Road Vehicles	PCC	3	0	2	5	4
3.	AM3203	Vehicle Body Engineering and Ergonomics	PCC	3	0	0	3	3
4.	AM3204	Vehicle Electrical and Electronics System cum Laboratory	PCC	3	0	3	6	4.5
5.	AM3205	Vehicle Management Systems	PCC	3	0	0	3	3
6.		Professional Elective – I	PEC	3	0	0	3	3
PRACTICAL								
7	AM3211	Engine and Vehicle Testing Laboratory	PCC	0	0	3	3	1.5
8	AM3212	Technical Seminar	EEC	0	0	4	4	2
			TOTAL	**18**	**0**	**12**	**30**	**24**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM3351	Electric and Hybrid Vehicles	PCC	3	0	0	3	3
2.		Professional Elective – II	PEC	3	0	0	3	3
3.		Professional Elective – III	PEC	3	0	0	3	3
4.		Professional Elective – IV	PEC	3	0	0	3	3
PRACTICAL								
5.	AM3311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**12**	**24**	**18**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICAL								
1.	AM3411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 77

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FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA3155	Advanced Numerical Methods	4	0	0	**4**	**I**

PROFESSIONAL CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1	AM3101	Automotive Chassis	3	1	0	**4**	**I**
2	AM3102	Automotive Transmission	3	0	0	**3**	**I**
3	AM3103	Engine and Auxiliary Systems	3	0	0	**3**	**I**
4	AM3104	Vehicle Design cum Laboratory	3	0	3	**4.5**	**I**
5	AM3111	Engine and Chassis Components Laboratory	0	0	3	**1.5**	**I**
6	AM3201	Automotive Pollution and Control	3	0	0	**3**	**II**
7	AM3202	Dynamics of Road Vehicles	3	0	2	**4**	**II**
8	AM3203	Vehicle Body Engineering and Ergonomics	3	0	0	**3**	**II**
9	AM3204	Vehicle Electrical and Electronics System cum Laboratory	3	0	3	**4.5**	**II**
10	AM3205	Vehicle Management Systems	3	0	0	**3**	**II**
11	AM3211	Engine and Vehicle Testing Laboratory	0	0	3	**1.5**	**II**
12	AM3351	Electric and Hybrid Vehicles	3	0	0	**3**	**III**

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM3151	Research Methodology and IPR	2	1	0	**3**	**I**

PROFESSIONAL ELECTIVES (PEC)

S.No	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
1	AM3001	Alternative Fuels and Propulsion Systems	PEC	3	0	0	3	**3**
2	AM3002	Automotive Aerodynamics	PEC	3	0	0	3	**3**
3	AM3003	Automotive Fault Diagnosis	PEC	3	0	0	3	**3**
4	AM3004	Automotive Instrumentation and Testing	PEC	3	0	0	3	**3**
5	AM3005	Automotive Materials	PEC	3	0	0	3	**3**
6	AM3006	Automotive Product Development	PEC	3	0	0	3	**3**
7	AM3007	Automotive Safety	PEC	3	0	0	3	**3**
8	AM3008	Autonomous and Connected Vehicles	PEC	3	0	0	3	**3**
9	AM3009	Design and Analysis of Experiments	PEC	3	0	0	3	**3**
10	AM3010	Engine Combustion Thermodynamics and Engine Heat Transfer	PEC	3	0	0	3	**3**
11	AM3011	Finite Element Methods in Automobile Engineering	PEC	3	0	0	3	**3**
12	AM3012	Hydraulic and Pneumatic Systems	PEC	3	0	0	3	**3**
13	AM3013	IC Engine Process Modelling	PEC	3	0	0	3	**3**
14	AM3014	Instrumentation and Experimental Techniques	PEC	3	0	0	3	**3**
15	AM3015	Intelligent Transport Systems	PEC	3	0	0	3	**3**
16	AM3016	Motorsport Technology	PEC	3	0	0	3	**3**
17	AM3017	Noise, Vibration and Harshness for Automobiles	PEC	3	0	0	3	**3**
18	AM3018	Production of Automotive Components	PEC	3	0	0	3	**3**
19	AM3019	Reverse Engineering in Automobile Engineering	PEC	2	0	2	4	**3**
20	AM3020	Special Purpose Vehicles	PEC	3	0	0	3	**3**
21	AM3021	Theory of Fuels and Lubricants	PEC	3	0	0	3	**3**
22	AM3022	Two and Three Wheelers	PEC	3	0	0	3	**3**
23	AM3023	Vehicle Air Conditioning Systems	PEC	3	0	0	3	**3**
24	AM3024	Vehicle Embedded Systems	PEC	3	0	0	3	**3**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	AM3212	Technical Seminar	0	0	4	**2**	**II**
2.	AM3311	Project Work I	0	0	12	**6**	**III**
3.	AM3411	Project Work II	0	0	24	**12**	**IV**
TOTAL CREDITS						**20**	

SUMMARY

M.E. AUTOMOBILE ENGINEERING						
S.No	Subject Area	Credits per Semester				Credits Total
		I	II	III	IV	
1	**FC**	4	0	0	0	**4**
2	**PCC**	16	19	3	0	**38**
3	**PEC**	0	3	9	0	**12**
4	**RMC**	3	0	0	0	**3**
5	**EEC**	0	2	6	12	**20**
	Total	**23**	**24**	**18**	**12**	**77**

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MA3155 **ADVANCED NUMERICAL METHODS** **L T P C**
4 0 0 4

OBJECTIVES

- To make the students understand the methods/algorithms to numerically solve a system of simultaneous algebraic equations.
- To make the students understand the methods to numerically solve the system of simultaneous ordinary differential equations.
- To make the students understand the methods to numerically solve the partial differential equations.
- To make the students understand the methods to numerically solve the elliptic equations.
- To make the students understand the finite element methods for solving the PDEs.

UNIT I ALGEBRAIC EQUATIONS **12**

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method, Faddeev – Leverrier Method.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS **12**

Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, collocation method, orthogonal collocation method, Galerkin finite element method

UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION **12**

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method; First order hyperbolic equations – method of characteristics, Lax-Wendroff explicit and implicit methods; numerical stability analysis, method of lines – Wave equation: Explicit scheme- Stability of above schemes

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS **12**

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

UNIT V FINITE ELEMENT METHOD **12**

Partial differential equations – Finite element method - collocation method, orthogonal collocation method, Galerkin finite element method.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, students will be able to

CO1 Solve numerically system of simultaneous algebraic equations.
CO2 Solve the simultaneous ordinary differential equations (IVP) numerically.
CO3 Solve numerically set of Partial differential equations.
CO4 Solve the set of Elliptic equations numerically.
CO5 Solve the set of PDEs by finite element method.

REFERENCES:

1. Burden. R. L. and Faires. J. D., "Numerical Analysis; Theory and Applications", India Edition, Cengage Learning, 2010.
2. Jain M.K., Iyengar S.R.K. and Jain R.K., Computational Methods for Partial Differential Equations, New Age International, 2nd Edition, New Delhi, 2016.
3. Morton K.W., and Mayers D.F., "Numerical Solution of Partial Differential Equations, Cambridge University Press, Second Edition, Cambridge, 2005.

4. Santosh K Gupta, “Numerical Methods for Engineers”, New Age International (P) Limited, Publishers, New Delhi, 2014.
5. Sastry S.S., "Introductory Methods of Numerical Analysis", Prentice - Hall of India Pvt. Limited, 5th Edition, New Delhi, 2012.
6. Saumyen Guha and Rajesh Srivastava, “Numerical methods for Engineering and Science”, Oxford Higher Education, New Delhi, 2010.

CO-PO Mapping:

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	2	2	3	3	2
2	3	3	3	3	2	2	3	3	2
3	3	3	3	3	2	2	3	3	2
4	3	3	3	3	2	2	3	3	2
5	3	3	3	3	2	2	3	3	2
AVG	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**2**

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AM3101	AUTOMOTIVE CHASSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

1.	To understand the basic knowledge about various vehicle frames, front axles, steering systems and understand the conditions for true rolling motion of wheels during steering.
2.	To recognize the construction and working principle of drive line, final drive and differential systems
3.	To review the knowledge about the constructional feature of rear axle, wheels and tyres.
4.	To evaluate the working principles of both conventional and independent suspension system.
5.	To demonstrate working principle of braking system used in automobile.

UNIT I **INTRODUCTION, FRAME, STEERING SYSTEM** **12**

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames, Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, EPAS.

UNIT II **PROPELLER SHAFT AND FINAL DRIVE** **12**

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Final drive, different types, Double reduction and twin speed final drives, Differential principle and types, limited speed differential.

UNIT III **AXLES AND TYRES** **12**

Construction and Design of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings and Types, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tyres and their constructional details.

UNIT IV **SUSPENSION SYSTEM** **12**

Need for Suspension System, Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi–Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Independent Suspension System, Telescopic Shock Absorbers.

UNIT V **BRAKING SYSTEM** **12**

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Leading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Activators, Disc Brake Theory, Types and Construction, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Anti–Lock Braking System.

TOTAL:45 PERIODS

COURSE OUTCOMES:	
CO1	Identify the different types of chassis layout, frames used in Automotive.
CO2	Appraise different types of drive line systems and steering system drives used in Automotive.
CO3	Acquire knowledge about different types of front axle and rear axles, wheel and tyre used in motor vehicles.
CO4	Expose to the working principle of conventional and independent suspension systems.
CO5	Analyse working principles of brake and its subsystems.

TEXTBOOKS:

1. Kirpal Singh, Automobile Engineering, Standard Publisher, New Delhi , 2017
2. K.K.Ramalingam, “Automobile Engineering”, scitech publication (India), 2011.
3. R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited, 2015

REFERENCES:

1. Heinz Hazler, Modern Vehicle Technology, Butterworth, London, 2005.
2. Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990
3. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
4. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007
5. William. H. Crows – Work shop Manuel – 2005

COs	POs						PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1	3	2	2	3	3	3	3	3	2
2	3	2	2	3	3	3	3	3	2
3	3	2	2	3	3	3	3	3	2
4	3	2	2	3	3	3	3	3	2
5	3	2	2	3	3	3	3	3	2
AVG	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**

AM3102	AUTOMOTIVE TRANSMISSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: The objective of this course is to prepare the students to gain knowledge in the construction and principle of mechanical transmission components like

1.	Clutch
2.	Gear Box
3.	Hydrodynamic devices
4.	Hydrostatic devices
5.	Automatic transmission system, Electric drive used in road vehicles.

UNIT I	CLUTCH	9

Requirement of transmission system, Types of transmission system, Requirement of Clutches – Functions-Types of clutches, construction and operation of Single plate, multi plate and Diaphragm spring clutches. Centrifugal clutch, DCT, Electronic clutch.

UNIT II	GEAR BOX	9

Purpose of gear box. Construction and working principle of sliding, constant and synchromesh gear boxes, Automatic manual transmission. Introduction to epicycle gear trains, Numerical examples on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & power and acceleration. Determination of gear ratios for different vehicle applications.

UNIT III	HYDRODYNAMIC TRANSMISSION	9

Fluid coupling – principles - Performance characteristics – advantages – limitations – drag torque – reduction of drag torque. Torque converter - principles - Performance characteristics – advantages – limitations – multistage and polyphase torque converters.

UNIT IV	HYDROSTATIC DRIVE	9

Hydrostatic drive; various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive.

UNIT V	AUTOMATIC TRANSMISSION AND ELECTRIC DRIVE	9

Wilson gear box- Cotal electric transmission. Chevrolet "Turboglide" transmission. – Four speed longitudinally mounted automatic transmission - Hydraulic control systems of automatic transmission. Continuously Variable Transmission (CVT) — types – Operations. Electric drive-types- Principle of early and modified Ward Leonard Control System-Advantages & limitations - Automated Manual Transmission (AMT) - Modern electric drives.

TOTAL:45 PERIODS

COURSE OUTCOMES: At the end of the course, students will be able to

CO1	Understand the construction and working of various types of clutches
CO2	Determine the gear ratio for different vehicle applications
CO3	Describe the types and principle of hydrodynamic transmission
CO4	Compare Hydrostatic and hydrodynamics drives
CO5	Identify the differences among various automatic transmissions.

TEXT BOOKS:

1. Heinz Heisler, "Advanced Vehicle Technology",2nd Edition,2002, Butterworth-Heinemann
2. T. K. Garrett K. Newton W. Steeds, "Motor Vehicle", 13th Edition, 2000, Butterworth-Heinemann

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REFERENCES:

1. Crouse, W.H., Anglin, D.L., “Automotive Transmission and Power Trains construction”, McGraw Hill, 1976.
2. Heldt, P.M., “Torque converters”, Chilton Book Co., 1962.
3. Iqbal Husain, “Electric and Hybrid Vehicles Design Fundamentals”, CRC PRESS Boca Raton London New York Washington, D.C.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	2	2	2	3	3	2
2	3	2	2	2	2	2	3	3	2
3	3	2	2	2	2	2	3	3	2
4	3	2	2	2	2	2	3	3	2
5	3	2	2	2	2	2	3	3	2
AVG	3	2	2	2	2	2	3	3	2

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AM 3103	ENGINE AND AUXILLARY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To impart knowledge on basics of automotive SI and CI engines consisting of types, construction, working
2.	To understand the engine induction and ignition and its functional requirements
3.	To learn the properties of gasoline and diesel fuel and combustion process involved in diesel engines
4.	To impart the knowledge on engine cooling and lubrication requirements also to understand the requirements of supercharger and turbocharger
5.	To analyze the performance characteristics of SI and CI engine and learn modern developments in IC engine

UNIT I	**ENGINE BASIC THEORY**	**9**

Introduction - Engine types – Operating cycle - Otto, diesel, dual operating cycles – Fuel air cycle and actual cycles –- Two and four stroke engines - Engine design and operating parameters - Typical performance and pollution curves for automobile engines – Rotary Engine - Problems on cycles.

UNIT II	**FUEL SUPPLY AND IGNITION SYSTEMS**	**9**

Objective and theory of carburetion - carburetors, Types, Additional system and modern devices of carburetor — Calculation of air fuel ratio of carburetor - Diesel fuel injection objective and types - pumps and injectors, Introduction to Petrol Injection system - conventional ignition systems, advance mechanisms – Electronic Ignition - Problems on carburetor and diesel fuel injection.

UNIT III	**AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS**	**9**

Combustion stoichiometry- Combustion reactions - Combustion in SI and CI engines – Factors affecting combustion in SI and CI engine - Premixed and diffused combustion, laminar and turbulent combustion of fuels in engines. Droplet combustion. Comparison of knock in CI & SI engines. Direct and indirect injection combustion chambers for diesel combustion. Cylinder pressure data and heat release analysis.

UNIT IV	**ENGINE COOLING, LUBRICATING SYSTEMS AND SUPERCHARGING, TURBOCHARGING**	**9**

Need of cooling and lubrication- Air cooling and water cooling – Types - Fins and radiator – Heat Balance in SI and CI engines - Design calculation. Theory of lubrication — types of lubrication - Properties of engine lubricants. Supercharger and Turbochargers – Types - Modification of an engine for supercharging. Effect of supercharging on engine performance. Variable geometry and variable nozzle turbocharger. E-Turbocharger. Problems on heat Transfer.

UNIT V	**NEW ENGINE TECHNOLOGY**	**9**

Lean Burn engine – Different approaches to lean bum – LHR engine – Surface ignition & catalytic ignition – Laser ignition - homogenous charge compression ignition – variable valve timing – Multi Port Injection System - Gasoline Direct Injection – Common Rail Direct Injection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, Student can able to

CO1	Understand and remember engine glossaries, identify various components of SI and CI engines and its principle of working
CO2	Define and interpret the knowledge on fuel induction system.
CO3	Illustrate and correlate the knowledge on engine combustion and its various effects
CO4	Explain and apply their knowledge in analyzing the requirement of engine sub systems.

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CO5	Analys and Evaluate engine performance and exposed to gain knowledge on recent developments of prime sources

TEXTBOOKS:

1. John B.Heywood , " Internal Combustion Engines" , McGraw-Hill Book Company, ISBN No: 0-07-100499-8
2. M.L. Mathur and R.P.Sharma, Internal Combustion Engine, Dhanpath Rai Publications (P) Ltd, New Delhi 110002
3. V. Ganesan, Internal Combustion Engines, Tata-McGraw Hill Publishing Co., New Delhi,

REFERENCES:

1. Heinz Hesiler, Advanced engine technology. Butterworth Heinmann publications
2. Heldt, P.M., High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta,
3. K. K. Ramalingm, internal Combustion Engines, Scitech publications, Chennai, 2003.
4. Maleev, V.M., Diesel Engine Operation and Maintenance, McGraw Hill, 1974.
5. Obert, E.F., Internal Combustion Engine analysis and Practice, International Text Book Co.,Scranton, Pennsylvania, 1988.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	3	3	3	3	3	3	3	3	2

AM3104	VEHICLE DESIGN CUM LABORATORY	L	T	P	C
		3	0	3	4.5

(Use of Design Data Book is permitted)

COURSE OBJECTIVES:

1.	To understand the various steps involved in the design of automotive components
2.	To show their knowledge in designing engine components.
3.	To complete design exercise and arrive at important dimensions of chassis components.
4.	To learn the use of standard practices in design.
5.	To determine the dimensions of front and rear axles

UNIT I	DESIGN OF CYLINDER, PISTON AND CONNECTING ROD	18

Choice of material for cylinder and piston, design of cylinder, design of piston, piston pin, piston rings and piston assembly. Material for connecting rod, design of connecting rod assembly. Case study on piston for car

UNIT II	DESIGN OF CRANK SHAFT AND VALVES	18

Material for crankshaft, design of crankshaft under bending and twisting. Design - inlet & exhaust valves, tappets. Design of cam & camshaft. Design of rocker arm.

UNIT III	DESIGN OF CLUTCHES AND GEARS	18

Design of single plate clutch, multiplate clutch and cone clutch assembly. Torque capacity of clutch. Design of clutch components. Gear train calculations, layout of gearboxes. Calculation of bearing loads and selection of bearings. Design of three speed and four speed gearboxes.

UNIT IV	DESIGN OF VEHICLE FRAME AND SUSPENSION	18

Study of loads-moments and stresses on frame members. Design Of frame for passenger and commercial vehicle. Design of leaf Springs-Coil springs and torsion bar springs - Determination of steering torque, -design of linkages, steering gear box - Case study on development of frame for ATV.

UNIT V	DESIGN OF FRONT AND REAR AXLE	18

Design of propeller shaft. Design of final drive gearing. Design -full floating, semi- floating and three-quarter floating rear shafts and rear axle housings. Analysis of loads-moments and stresses at different sections of front axle. Design procedure for front axle

PRACTICALS

ENGINE DESIGN EXPERIMENTS

1. Design and modelling of combustion chamber.
2. Design and modelling of piston, piston pin and piston rings.
3. Design and modelling of the connecting rod assembly.
4. Design and modelling of the crankshaft assembly.
5. Design and modelling of the inlet and exhaust valves.

CHASSIS DESIGN EXPERIMENTS

1. Design and modelling of frame
2. Design and modelling of clutch assembly.
3. Design and modelling of gearbox
4. Design and modelling of propeller shaft with universal joint.
5. Design and modelling of rear axle

TOTAL :	90 PERIODS

COURSE OUTCOMES:	
The students will be able to	
CO1	Analyze the stress and strain imparted on automotive components
CO2	Compute the design and find the dimension of the vehicle components.
CO3	Identify optimal design solutions to real-world problems in compliance with industry standards.
CO4	Demonstrate the design skill by creating new design strategy with the application of the knowledge.
CO5	Interpret the modern system in vehicle and would help in developing the system with less impact to the environment.

TEXT BOOKS:

1. Genta, Lorenzo Morello, “The Automotive Chassis Volume 1, Components Design”, Springer International Edition.2014
2. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.
3. Stokes, “Manual gearbox design”, Butterworth-Heinemann 1992

REFERENCES:

1. “Design Data Hand Book”, PSG College of Technology, 2013- Coimbatore.
2. Dean Averns, "Automobile Chassis Design", Illife Book Co., 2001.
3. Kolchin-Demidov, “Design of Automotive Engines”-Mir Publishers (1984)
4. Lukin P G and Rodionov V, “Automobile Chassis Design and Calculations”, Mir Publishers, Moscow, 1989.
5. Robert C . Juvinall and Kurt M. Marshek, “ Fundamentals of Machine component Design”,6th Edition, Wiley, 2017

COs	POs						PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

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RM3151 RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	1	0	3

OBJECTIVES:

To impart knowledge on

- Formulation of research problems, design of experiment, collection of data, interpretation and presentation of result
- Intellectual property rights, patenting and licensing

UNIT I RESEARCH PROBLEM FORMULATION 9

Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap

UNIT II RESEARCH DESIGN AND DATA COLLECTION 9

Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING 9

Sampling, sampling error, measures of central tendency and variation,; test of hypothesis- concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9 Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, Copy rights, applicability of these IPR; , IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance.

UNIT V PATENTS 9 Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student can

CO1: Describe different types of research; identify, review and define the research problem
CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data
CO3: Explain the process of data analysis; interpret and present the result in suitable form
CO4: Explain about Intellectual property rights, types and procedures
CO5: Execute patent filing and licensing

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,
3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

AM3111	ENGINE AND CHASSIS COMPONENTS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

1. To assemble and disassemble the parts of an IC engine.
2. To identify the various component of an IC engine.
3. To identify the various components in the transmission systems of an automobile.
4. To assemble and disassemble the various components of transmission system.
5. To study all the functions of automobile components

LIST OF EXPERIMENTS

1. To assemble and dismantle the Bus engine
2. To assemble and dismantle the V8 engine
3. To assemble and dismantle the CRDI engine
4. To assemble and dismantle the MPFI engine
5. To assemble and dismantle a Single plate, Diaphragm Clutch.
6. To assemble and dismantle a Constant-mesh, Sliding mesh gearbox
7. To assemble and dismantle the Transfer case
8. To assemble and dismantle the Differential, Rear axle
9. To assemble and dismantle the Front axle. Constant Velocity Joint.
10. To Study different chassis layouts
11. To Study the braking system
12. To Study the Suspension system

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1 Dismantle and Assemble the Engine components
CO2 Identify & differentiate components of the Clutch and Gearbox,
CO3 Understand the working of braking, Breaking and Suspension systems.
CO4 Develop skills in Dismantling and assembling chassis components.
CO5 Dismantle and Assemble axles differential.

COs	POs						PSOs		
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1	3	2	2	3	3	3	3	3	2
2	3	2	2	3	3	3	3	3	2
3	3	2	2	3	3	3	3	3	2
4	3	2	2	3	3	3	3	3	2
5	3	2	2	3	3	3	3	3	2
AVG	3	2	2	3	3	3	3	3	2

AM3201	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To discuss the harmful effects of major pollutants on living beings and the environment
2. To analyze the formation of major pollutants like UBHC, CO, NOx, particulate matter and smoke.
3. To design various control techniques to reduce pollutants in combustion
4. To determine the various after treatment process to minimize emissions
5. To demonstrate the various devices used to measure pollutants and discuss the Emission standards followed in various nations

UNIT I EMISSION FROM AUTOMOBILES 9

Sources of Pollution, Various emissions from Automobiles — Formation — Effects of pollutants on environment and human health – Evaluation of emission standards. Lubricants handling and harmful discharges. Introduction to CO2 emission, Carbon capturing, Introduction to Electro Magnetic Emissions, and Functional Safety of emission control devices.

UNIT II EMISSION FROM SPARK IGNITION ENGINE AND ITS CONTROL 9

Emission formation in SI Engines- Carbon monoxide- Unburned hydrocarbon, NOx, Smoke Aldehyde emissions - Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, types of substrate and catalyst, Low temperature catalyst and activation— Charcoal Canister — Positive Crank case ventilation system, Secondary air injection, Thermal reactor, Laser Assisted Combustion. CO_2 control Techniques, Pre, Post and Oxy fuel combustion, Absorption, Adsorption and membrane separation.

UNIT III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL 9

Formation of White, Blue, and Black Smokes, NOx, soot, Sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of Operating variables on Emission formation — Fumigation, EGR, HCCI, Turbo charger, Particulate Traps, Re-generation methods, SCR — Cetane number Effect.

UNIT IV NOISE POLLUTION FROM AUTOMOBILES 9

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

UNIT V TEST PROCEDURES AND EMISSION MEASUREMENTS 9

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dyno – Transient dyno, Seven mode and thirteen mode cycles for Emission Sampling — Sampling problems — Emission analyzers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel for PM measurement and Laser scattering method for PN measurement, SHED Test, Sound level meters. Homologation, EMC/EMI testing of Electric electronic devices. On-board pollution measurement equipment's (PEMS). Emission regulations for off-road vehicles, TREM norms.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Differentiate the various emissions formed in IC engines
CO2 Analyze the effects of pollution on human health and environment
CO3 Design the control techniques for minimizing emissions
CO4 Identify suitable methods to reduce the noise emissions.
CO5 Categorize the emission norms

TEXT BOOKS:

1. B.P Pundir , Engine Emissions, Narosa publications 2nd edition 2017
2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.
3. G.P.Springer and D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

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AM3202	DYNAMICS OF ROAD VEHICLES	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

1.	To provide fundamental knowledge of the vibration,
2.	To impart knowledge on tyres
3.	To provide basic concepts on suspension design and function, ride modes
4.	To Evaluate the performance, longitudinal dynamics and control in an automobile
5.	To provide basic analysis on handling, cornering stability and control

UNIT I **CONCEPT OF VIBRATION** **15**

Modelling and Simulation, Global and Vehicle Coordinate System. Fundamentals of vibration - Definitions, Types, Free, Forced, Undamped and Damped Vibration. Vibration analysis – Formulation of Governing equation. Response Analysis of Single DOF, Two DOF, Multi DOF. Magnification factor, Transmissibility ratio, Base excitation. Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed.

UNIT II **TYRES** **15**

Tyre axis system, Construction and manufacturing of tires, tyre forces and moments, tyre marking, tyre structure, hydroplaning, wheel and rim. Rolling resistance, factors affecting rolling resistance. Tire slip – Longitudinal slip and slip angle concept, Relation between tractive effort and longitudinal slip, Friction circle. Longitudinal and Lateral force at various slip angles, Tractive and cornering property of tire. Camber and camber trust. Performance of tire on wet surface. Ride property of tyres. Various test carried on a tyre. Tyre models

UNIT III **VERTICAL DYNAMICS** **15**

Human response to vibration, Sources of Vibration. Suspension requirements – types. State Space Representation. MR & ER Dampers. Design and analysis of Passive, Semiactive and Active suspension using Quarter car, Bicycle Model, Half car and full car vibrating model. Influence of suspension stiffness, suspension damping, and tire stiffness. Control law. Suspension optimization techniques. Air suspension system and their properties.

UNIT IV **LONGITUDINAL DYNAMICS AND CONTROL** **15**

Aerodynamic forces and moments. Forces acting on a vehicle – Resistance forces, Traction force supplied by power plant. Equation of motion. Load distribution for three-wheeler and four-wheeler. Calculation of maximum acceleration, tractive effort and reaction forces for different drive vehicles. Power limited acceleration and traction limited acceleration. Estimation of CG location. Longitudinal load transfer during acceleration and braking. Stability of vehicles resting on slope. Driveline dynamics. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control.

UNIT V **LATERAL DYNAMICS** **15**

Steering Geometry – Steady state handling characteristics. Steady state response to steering input – Yaw velocity gain, Lateral acceleration gain, curvature response gain. Testing of handling characteristics. Transient response characteristics. Directional stability. Stability of vehicle on banked road, during turn. Effect of suspension on cornering. Roll dynamics - Roll centre, Roll axis, effect of roll on vehicle dynamics. Yaw control. Stability control.

PRACTICALS

Simulation and analysis of

1. Single and Multi-Degree of Freedom System
2. Longitudinal and lateral forces of tires using Magic Formula Tire model

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3. Passive Suspension System using Quarter / Half / Full Car model
4. Active Suspension System Control Strategy (PID, Skyhook, LQR) using Quarter / Half / Full Car model
5. Power requirement for a Vehicle
6. Double lane change maneuver
7. Mini-Project

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the courses, the students can able to

CO1	Develop physical and mathematical models of a mechanical vibrating system
CO2	Indicate the forces and moment acting on tyres
CO3	Identify the suspension parameters that governs ride comfort
CO4	Evaluate the vehicle performance in longitudinal direction
CO5	Evaluate the lateral dynamics and control in an automobile

TEXT BOOKS:

1. Singiresu S. Rao, "Mechanical Vibrations – SI Edition," Sixth Edition, Pearson, 2018
2. J. Y. Wong, "Theory of Ground Vehicles", Fifth Edition, Wiley-Interscience, 2022
3. Rajesh Rajamani, "Vehicle Dynamics and Control," Second edition, Springer, 2012
4. Reza N. Jazar, "Vehicle Dynamics: Theory and Application", Third edition, Springer, 2017

REFERENCES:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Revised Edition, Society of Automotive Engineers Inc, 2021
2. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", Second Edition, CRC Press, 2013
3. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics", 2nd Edition, Butterworth - Heinemann, 2014
4. Hans B Pacejka, "Tyre and Vehicle Dynamics," Second edition, Butterworth - Heinemann, 2006

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

AM3203	VEHICLE BODY ENGINEERING AND ERGONOMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	Import the knowledge on Car body
2.	Bus body
3.	Commercial vehicle
4.	Vehicle aerodynamics
5.	Ergonomics

UNIT I	CAR BODY DETAILS	9

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car –car body terminology - Visibility- regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car Body Construction - Various panels in car bodies – body materials. Safety: Safety design, safety equipment for cars – body correction – modern painting process.

UNIT II	BUS BODY DETAILS	9

Types of bus body: based on capacity, distance travelled and based on construction. – Bus body lay out, floor height, engine location, entrance and exit location. Types of metal sections used – Regulations – Constructional details: Conventional and integral.

UNIT III	COMMERCIAL VEHICLE DETAILS	9

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

UNIT IV	VEHICLE AERODYNAMICS	9

Objectives, Vehicle drag and types. Various 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 balance.

UNIT V	ERGONOMICS	9

Introduction to Automotive Ergonomics, Ergonomics in Vehicle Design, Anthropometry in Designing Vehicles, Occupant Package, Controls and Displays Interface - Introduction to Field of View - styling in automotive design.

TOTAL: 45

COURSE OUTCOMES:

Upon completion of the course, students will acquire knowledge on

CO1	Different aspects of car body,
CO2	Bus body
CO3	Commercial vehicle bodies.
CO4	Role of various aerodynamic forces and moments, measuring instruments in vehicle body design
CO5	Ergonomics

TEXTBOOKS:

1.Dieler Anselm., "The passenger car body", SAE International, 2000
2. James E Duffy, "Body Repair Technology for 4-Wheelers", Cengage Learning,2009.
3. Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 1998.

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REFERENCES:
1. Braithwaite, J.B., “Vehicle Body building and drawing”, Heinemann Educational Books Ltd., London, 1997.
2. Giles, G.J., “Body construction and design”, Iliffe Books Ltd. Butterworth & Co., 1991.
3. John Fenton, “Vehicle Body layout and analysis”, Mechanical Engg. Publication Ltd., London,1992.
4. Vivek D. Bhise,” Ergonomics in The Automotive Design Process”, CRS Press,2016

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	2	2	2	3	3	2
2	3	2	2	2	2	2	3	3	2
3	3	2	2	2	2	2	3	3	2
4	3	2	2	2	2	2	3	3	2
5	3	2	2	2	2	2	3	3	2
AVG	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**

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AM3204	VEHICLE ELECTRICAL AND ELECTRONICS SYSTEM CUM LABORATORY	L	T	P	C
		3	0	3	4.5

COURSE OBJECTIVES:

1.	To understand the need for different electrical circuits, starter batteries, starter motor and alternator in the vehicle.
2.	To give exposure and understand the need for power electronics devices, controlled rectifiers, AC voltage controllers and choppers in automobile applications
3.	Overview on ignition, lighting and auxiliary system used in modern vehicles
4.	To list common types of sensor and actuators used in vehicles.
5.	To understand and differentiate the conventional and modern architecture networking in vehicles

UNIT I	FUNDAMENTALS OF ELECTRICAL CIRCUITS, BATTERY, STARTING AND CHARGING SYSTEMS	18

D.C fundamentals: ohm's law, KVL & KCL law, AC Fundamentals: Analysis of simple RC, RL and RLC series and parallel circuits and phasor diagrams. Lead acid battery: - Design, operating principle, characteristics, ratings and testing. Alternators: – Generation of electrical energy in the vehicle-constructional details and Operating Principle, Voltage regulation, Overvoltage regulation, characteristics curve- Alternator circuits and designs. Starter Motors: - Overview, Working phases of the pre-engaged drive Starter Types of starter motor- starter motor design - Starter motor design variations – starter motor control and power circuits

UNIT II	INDUCTION MOTOR & DRIVES	18

Construction and principle of operation - torque and torque-slip characteristics-Efficiency- Application-starting methods – speed control drives of induction motor.

UNIT III	POWER ELECTRONICS AND CONVERTORS	18

Power diodes and its characteristics - BJT, MOSFET, IGBT, SCR- Controlled Rectifiers and AC voltage Controllers, DC to DC Converters- Buck, Boost, Buck-Boost converters, Inverters- voltage, current, resonant

UNIT IV	TRANSDUCERS AND SIGNAL CONDITIONING	18

Transducer characteristics and classification, variable resistance-based transducers- strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor, variable inductance-based transducers- LVDT, Induction potentiometer, Capacitive transducers- Capacitive pressure sensor, Proximity sensor- Piezoelectric transducer – Hall Effect transducer- automotive application of sensors, DAC and ADC principle, ADC IC's

UNIT V	EMBEDDED SYSTEM AND VEHICLE NETWORKING	18

Introduction to Embedded Systems –built in features for embedded Target Architecture (ARM processor) – selection of Embedded processor – DMA- memory devices – Memory management methods-memory mapping, cache replacement policies- Timer and Counting devices, Watchdog Timer, Real Time Clock- Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, In-circuit emulator, Target Hardware Debugging. Principles of data transfer within automotive electronics systems, including networking fundamentals such as network topology, organization, and the OSI reference model- Examine control mechanisms, communication protocols in embedded systems, vehicle communication protocols, cross-system functions, and requirements for bus systems- Classify bus systems, investigate their applications in vehicles- network coupling-examine real-world examples of networked vehicles and specific bus systems like CAN, LIN, FlexRay, and MOST

PRACTICALS

1. Study and testing of Lead acid battery used in vehicles
2. Study and testing of starting motor and alternator used in vehicles
3. Simulation and analysis of automotive Stator motor and Alternator using any e-CAD tools
4. Simulation of single-phase half and full wave-controlled converter fed RLE load using any e-CAD tools.
5. Simulation of three phase half and full controlled converter fed RL load using any e-CAD tools.
6. Computer based data acquisition for vibration measurement using Accelerometer in the Single-Phase Induction motor.
7. Computer based data acquisition for the Temperature measurement using thermocouple and LVDT
8. Computer based programming exercises / Experiments with Embedded Kit using Embedded 'C 'for
    a) Interfacing of input devices (Switches and keypad)
    b) Interfacing of output devices (Actuators and Display Devices)
9. Computer based programming exercises / Experiments with Embedded Kit using Embedded 'C' for
    a) Timers / Counters
    b) Interrupts
10. Using DSO to measure and analyze the following
    a. Repetitive ringing, sine wave & sine with glitch signals
    b. CAN bus & I2c protocol signals
    c. Different waveforms using Functional generator

TOTAL :	**90 PERIODS**

COURSE OUTCOMES:

CO1	Develop an understanding of the significance of electrical circuits, starter batteries, and the starting and charging system within vehicles
CO2	Provide an illustrative explanation of the construction, principles, and speed control mechanisms utilized in induction motors
CO3	Gain exposure to and understand the necessity of power electronics devices, controlled rectifiers, AC voltage controllers, and choppers in automotive applications
CO4	Categorize and elucidate the operational principles of various types of transducers and signal conditioning employed in vehicles
CO5	Understand and differentiate the conventional and modern architecture networking in vehicles

TEXT BOOKS:

1. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5
2. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009

REFERENCES:

1. Rashid, M.H., "Power Electronics – Circuits, Devices and Applications", PHI, Fourth edition, 2014.
2. NPTEL Lecture Series on "Power Electronics" by Dr.B.G.Fernandes, IIT Bombay
3. Allan R. Hambley, "Electrical Engineering -Principles & Applications", 2019, 6th Edition, Pearson Education
4. V. D. Toro, Electrical Engineering Fundamentals, 2nd edition. PHI, 2014
5. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 11th edition. Pearson, 2012

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COs	POs						PSOs		
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1	3	3	3	3	3	3	3	3	2
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4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

Attested

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AM3205	VEHICLE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To understand the basics of control system used in automobiles
2.	To recognize the electronically controlled system used in driving mechanics.
3.	To understand the working principle of driver modelling and power train control systems.
4.	To identify the control system used in hybrid and electrical vehicles.
5.	To illustrate the need of automated transport systems

UNIT I	INTRODUCTION	9

Components of chassis management system – role of various sensors and actuators pertaining to chassis system – construction – working principle of wheel speed sensor, steering position, tyre pressure, brake pressure, steering torque, fuel level, Engine and vehicle design data

UNIT II	DRIVELINE CONTROL SYSTEM	9

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

UNIT III	SAFETY AND SECURITY SYSTEM	9

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

UNIT IV	COMFORT SYSTEM	9

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

UNIT V	INTELLIGENT TRANSPORTATION SYSTEM	9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1	Understand the basics of control system used in automobiles
CO2	Recognize the electronically controlled system used in driving mechanics.
CO3	Understand the working principle of driver modelling and power train control systems.
CO4	Identify the control system used in hybrid and electrical vehicles.
CO5	Illustrate the need of automated transport systems.

REFERENCES:

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

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	3	3	3	3	3	3	3	3	2

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AM3211	ENGINE AND VEHICLE TESTING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

1.	To impart knowledge in automotive Emission measurement and methods of testing engines.
2.	To categorize the different measuring techniques of pollutants like UBHC, CO, NOx, CO_2 and smoke.
3.	To Investigate the performance and combustion parameters for different engine models
4.	To learn removal and fitting of automotive accessories
5.	To understand the adjustment of play in various automobile components.

LIST OF EXPERIMENTS

ENGINE TESTING:

1. Performance test and emission test on engine.
2. Determine the Frictional power test on petrol engines.
3. Heat balance test on Diesel engine.
4. Determination of Volumetric efficiency on diesel Engine.
5. Retardation Test On 4-Stroke, Single Cylinder Diesel Engine Test Rig
6. Morse test to determine Indicated power for multi-cylinder SI Engine
7. To find the effect of Injection timing and Injection Pressure on emission formation

VEHICLE TESTING:

1. Tightening and adjustment of wheel bearing.
2. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel orientation.
3. Wheel alignment in four wheelers.
4. Service of transmission, braking and suspension systems.
5. Work on body and paint shop.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1	Analysis of combustion parameters
CO2	Differentiate the variation performance parameters of Petrol engines
CO3	Differentiate the variation performance parameters of diesel engines
CO4	Learn removal and fitting of automotive accessories
CO5	Understand the adjustment of play in various automobile components.

COs	POs						PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1	3	2	2	3	3	3	3	3	2
2	3	2	2	3	3	3	3	3	2
3	3	2	2	3	3	3	3	3	2
4	3	2	2	3	3	3	3	3	2
5	3	2	2	3	3	3	3	3	2
AVG	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**

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AM3351	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. General aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control.
2. Understand about vehicle dynamics,
3. Design the required energy storage devices,
4. Select the suitable electric propulsion systems and
5. Understand of hybrid electric vehicles.

UNIT I NEED FOR ALTERNATIVE SYSTEM 9

Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems

UNIT III ENERGY STORAGE DEVICES AND SOURCES 9

Battery Parameters- - Different types of batteries. Battery Chemistry, Battery Modelling, Battery Management System, Thermal Management system. Ultra-capacitors. Fuel Cell, Characteristics- Fuel cell types- Electrolytic reactions of fuel cell. Cell Chemistry.

UNIT IV MOTORS AND CONTROLLERS 9

Types of Motors, Characteristic of DC motors, AC single phase and 3-phase motor, PM motors, switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/DC converters.

UNIT V SUBSYTEMS OF HYBRID AND ELECTRIC VEHICLES 9

Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid and Electric Vehicle- Economy of hybrid Vehicles.

TOTAL: 45

COURSE OUTCOMES:

CO1 Understand need and working of different configurations of hybrid and electric vehicles
CO2 Design and develop basic systems of electric vehicles and hybrid electric vehicles.
CO3 Choose proper energy storage systems for EV applications
CO4 Choose a suitable drive system for developing an electric and hybrid vehicle depending on resources
CO5 Understand basic operation of power-split device and control Strategies for hybrid and electric vehicle.

TEXTBOOKS:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “John Wiley & Sons,2003
2. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2003
3. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press,2005

REFERENCES:

1. Ron Hodkinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication,2005
2. Lino Guzzella, “Vehicle Propulsion System” Springer Publications,2005

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

AM3001	ALTERNATIVE FUELS AND PROPULSION SYSTEMS	L	T	P	C

		3	0	0	3

COURSE OBJECTIVES:

1.	To acquire knowledge on availability of renewable fuels in the world and the technologies used for biofuel production
2.	To understand the challenges and difficulties involved in using alternative fuels in internal combustion engines
3.	To acquire complete knowledge on availability of possible alternate fuels and their properties to use as fuel in CI and SI engines
4.	To explore the possible methods of using all the renewable fuels in SI and CI engines and analyze the engines behavior with different fuels and methods
5.	To develop a complete understanding of changing the engine system, modifying the fuel for efficient use in engines

UNIT I	**ALTERNATIVE FUELS, PROPERTIES AND PRODUCTION METHODS OF FUELS**	**9**

Need for alternative fuels. World and Indian energy scenario on alternative fuels. Production technologies for biofuels for internal combustion engines- Pyrolysis, gasification, digestion.

UNIT II	**ALCOHOLS**	**9**

Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance, emission and combustion characteristics in CI and SI engines. Calculation of Performance parameters. Recent Trends.

UNIT III	**VEGETABLE OILS**	**9**

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils - Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines. Role of Nano fluids, additives and cetane improvers for performance improvement of vegetable oils as fuel. Calculation of Performance parameters. Recent Trends.

UNIT IV	**HYDROGEN**	**9**

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage - safety aspects of hydrogen. Recent Trends in Hydrogen research

UNIT V	**BIOGAS, LPG AND NATURAL GAS**	**9**

Production methods of Biogas, Natural gas and LPG. Properties studies. CO_2 and H_2S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines. Recent Trends in engine research.

TOTAL:	**45**

COURSE OUTCOMES:

CO1	To acquire knowledge on availability of renewable fuels in the world and the technologies used for biofuel production
CO2	To understand the challenges and difficulties involved in using alternative fuels in internal combustion engines
CO3	To acquire complete knowledge on availability of possible alternate fuels and their properties to use as fuel in CI and SI engines
CO4	To explore the possible methods of using all the renewable fuels in SI and CI engines and analyze the engines behavior with different fuels and methods
CO5	To develop a complete understanding of changing the engine system, modifying the fuel for efficient use in engines

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.).
6. Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	2	3	2	3	3	3	2
2	3	3	2	3	2	3	3	3	2
3	3	3	2	3	2	3	3	3	2
4	3	3	2	3	2	3	3	3	2
5	3	3	2	3	2	3	3	3	2
AVG	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**

AM3002	AUTOMOTIVE AERODYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	Understand the forces & moments influencing drag
2.	Assess the techniques of detail and shape optimizations for cars, commercial vehicles and motorcycles
3.	Expose to experimental testing and instrumentation

UNIT I	**SCOPE OF VEHICLE AERODYNAMICS**	**9**

Scope of vehicle aerodynamics. Properties of incompressible fluids. External and internal flow phenomena related to vehicles. Causes and effects of aerodynamic forces and moments. Impact of road load on vehicle motion. Performance potential, Fuel Consumption and fuel economy calculations. Strategies for low fuel consumption.

UNIT II	**AERODYNAMIC DRAG OF PASSENGER CARS**	**9**

Bluff body. Drag fractions and their local origins – forebody, windshield and A and C pillars, roof, rear end, plan view and side panels, underbody, wheels and wheel housings, front spoiler, rear spoiler. Strategies for aerodynamic development – Detail optimization, Shape optimization, Facelift, Adaptation of add-on devices.

UNIT III	**AERODYNAMIC DRAG OF COMMERCIAL VEHICLES**	**9**

Relation between tractive resistance, drag and fuel consumption. Aerodynamic drag coefficients of commercial vehicles. Drag reduction on delivery vans, trucks, and buses. Add-on devices for drag reduction. Vehicle soiling types, causes, effects and control measures.

UNIT IV	**MOTORCYCLE AERODYNAMICS**	**9**

Development of motorcycle aerodynamics. Riding dynamics and its relationship with aerodynamics. Methods of measurement in road tests. Rider influences - rider and pillion passenger. Clothing and helmets. Case studies on racing models.

UNIT V	**EXPERIMENTAL TESTING AND INSTRUMENTATION**	**9**

Wind tunnel – Types and Principle. Limitations with reduced scale models. Measuring Equipment and Transducers – Wind tunnel balance, hotwire anemometry, Pitot tube and transducers. Flow visualization techniques – Smoke, wool tuft, Particle image velocimetry. Introduction to computational fluid dynamics.

TOTAL: 45

COURSE OUTCOMES:

CO1	Comprehend the forces & moments influencing drag
CO2	Appraise the techniques of detail and shape optimizations for cars
CO3	Interpret the strategies of drag reduction in commercial vehicles
CO4	Investigate the factors influencing drag on motorcycles
CO5	Expose to experimental testing and instrumentation

TEXT BOOKS:

1. Alan Pope, Jewel B. Barlow, William H. Rae “Low-speed wind tunnel testing”, John Wiley & Sons, Third edition, 1999
2. Hucho. W.H. – “Aerodynamic of Road Vehicles – From Fluid Mechanics to Vehicle Engineering”, Society of Automotive Engineers, U.S, Fourth edition, 1998

REFERENCES:

1. R.H. Barnard - “Road vehicle aerodynamic design, An Introduction”, Mechaero publications, Third edition, 2010
2. T. Yomi Obidi - “Theory and Applications of Aerodynamics for Ground Vehicles”, SAE International, 2014

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

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AM3003	AUTOMOTIVE FAULT DIAGNOSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To import knowledge on

1.	Maintenance procedure
2.	Engine and subsystem maintenance
3.	Transmission system maintenance
4.	Electrical system
5.	Air conditioning and body repair

UNIT I	MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS	9

Need for Maintenance – importance, classification of maintenance work-basic problem diagnosis. Automotive service procedures – workshop – types - operations – workshop manual -. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments –Scheduled maintenance services – service intervals - On-board diagnostics.

UNIT II	ENGINE AND SUBSYSTEM MAINTENANCE	9

Engine service- Dismantling of Engine components - Engine tuning - repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls.

UNIT III	TRANSMISSION AND DRIVELINE MAINTENANCE	9

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of universal joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

UNIT IV	STEERING, BRAKE, SUSPENSION, WHEEL MAINTENANCE	9

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Wheel alignment and balance, removing and fitting of tires, tire wear and tire rotation. Inspection, Maintenance and Service of steering linkage, steering column, steering gear box service- Rack and pinion, Recirculating ball and Worm type and Power steering system.

UNIT V	AUTO ELECTRICAL, AIR CONDITIOING AND VEHICLE BODY MAINTENANCE	9

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault Diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

TOTAL:	45 PERIODS

COURSE OUTCOMES:

Upon the completion of the course student can able to understand

CO1	The importance of maintenance
CO2	Sub systems of engine
CO3	Transmission
CO4	Electric system
CO5	Body repair

TEXT BOOKS:

1. Ed May, “Automotive Mechanics” Volume One, Mc Graw Hill Publications, 2006
2. Ed May, “Automotive Mechanics” Volume Two, Mc Graw Hill Publications, 2006

REFERENCES:

1. Bosch Automotive Handbook, Tenth Edition,2018
2. Vehicle Service Manuals from different manufactures
3. William Crouse, Donald Anglin Automotive Mechanics
4. Denton, Advanced Automotive Fault Diagnosis Automotive Technology : Vehicle Maintenance and Repair,Routledge,2012

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	2	2	2	3	3	2
2	3	2	2	2	2	2	3	3	2
3	3	2	2	2	2	2	3	3	2
4	3	2	2	2	2	2	3	3	2
5	3	2	2	2	2	2	3	3	2
AVG	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**

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AM3004	AUTOMOTIVE INSTRUMENTATION AND TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To provide theoretical and applicative knowledge in automobile test instrumentation.
2.	To identify the various instruments for measuring force, torque, pressure, temperature, fluid flow, velocity and rotational speed.
3.	To enhance the knowledge of students regarding the experimental methods followed in industries.
4.	To familiarize the students on standard test codes.
5.	To impart skills on the testing procedure followed for evaluating brake, engine and

UNIT I	MECHANICAL MEASUREMENT	9

Introduction to measurements – Construction, principle, working of Instruments for measuring force, torque, pressure, temperature, fluid flow, velocity, rotational speed.

UNIT II	VIBRATION AND BODY TEST	9

Vibration measurement instrument – accelerometer and signal conditioning. Dynamic simulation sled testing, methodology, vehicle acceleration measurement and documentation. Dolly roll over test, dolly role over fixture, photographic / video coverage. Vehicle roof strength test –. Door system crush test – wind tunnel tests.

UNIT III	CRASH AND BRAKE TEST	9

Crash tests –standards – road hazard impact test for wheel and tyre assemblies, test procedures, failure and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements.

UNIT IV	ENGINE EXPERIMENTAL TECHNIQUES	9

I.S Code for Engine testing – Instruments for performance testing of engine, Instrumentation for measuring noise, vibration in cylinder, different types of engine tests are performed within the industry.

UNIT V	VEHICLE EXPERIMENTAL TECHNIQUES	9

Laboratory tests- test tracks - Endurance Tests - Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations.

TOTAL:	45 PERIODS

COURSE OUTCOMES:

CO1	Demonstrate the understanding of engine testing procedures.
CO2	Develop a measurement strategy for temperature, pressure, mass flow, velocity.
CO3	Understand sensors and instrumentation, and to analyze and interpret test data.
CO4	Develop new system that would help in keeping the environment sustainable.
CO5	Demonstrate the understanding of brake testing procedures

TEXT BOOKS:

1. Crouse W H and Anglin D L., “Automotive Mechanics”’ Tata McGraw Hill Publishing Company, 2004.
2. J.G .Giles, Vehicle Operation & Testing. Volume 7 of Automotive technology series, Iliffe,1969
3. Richard D. Atkins, “An Introduction to Engine Testing and Development”, SAE International 2009.

REFERENCES:

1. Beckwith TG and Buck N L, “Mechanical Measurements”, Addition Wesley Publishing Company Limited, 1995.
2. Jain R K “Mechanical and Industrial Measurements”, Khanna Publishers, Delhi, 1999.
3. Stockel M W, “Auto Mechanics Fundamentals”, Good Heart-Wilcox Co., Inc., 2000.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	3	3	3	3	3	3	3	3	2

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AM3005	AUTOMOTIVE MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To knowledge on properties of engineering materials
2.	To select suitable materials for design
3.	To select Materials for engine and transmission systems
4.	To select materials used for automotive structures.
5.	To select electronic materials for automotive applications

UNIT I **ENGINEERING MATERIALS AND THEIR PROPERTIES** **9**

Classes of engineering materials - the evolution of engineering materials, Definition of materials properties, displaying material properties using materials selection charts, Forces for change in materials selection and design, Materials and the environment-selection of materials for automotive, aerospace, marine and defense applications

UNIT II **BASIS OF MATERIAL SELECTION** **9**

Selection strategy, Attribute limits and Material indices, structural index Selection procedure: Design process - types of design, design requirements, Function, Material attributes, Shape and Manufacturing processes - Materials processing and design processes and their influence on design, Process attributes, Systematic process selection, Process selection diagrams, Process cost, Energy consumption for production, Material costs, Availability, Recyclability, Environmental consideration. Computer aided selection. Case study

UNIT III **MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS** **9**

Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Inlet & Exhaust valves, Cylinder Liners, Radiator fins, Connecting rod, Cam and Cam Shaft, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches, Turbo charger plates

UNIT IV **MATERIALS FOR AUTOMOTIVE STRUCTURES** **9**

Materials selection for bearings, leaf springs, Coil spring, chassis & frames, Bumper, shock absorbers, Propeller shaft, axle shaft, wind screens, panels, brake shoes, Disc, wheels, differentials, damping and antifriction fluids, Tyres and tubes

UNIT V **ELECTRONIC MATERIALS FOR AUTOMOTIVE APPLICATIONS** **9**

Materials for electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, anti-collision, Anti-fog, Head lamps, Air bag, Adaptive cruise control.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1	Summarize properties of engineering materials
CO2	Choose suitable materials for design of automotive components
CO3	Select Materials for IC engine and transmission systems
CO4	Recommend the materials used for automotive structures.
CO5	Decide suitable electronic materials for automotive electrical and electronics applications

TEXT BOOKS:

1. Ahmed Elmarakbi," Advanced Composite Materials for Automotive Applications - Structural Integrity and Crashworthiness", John Wiley & Sons Ltd, 2014.
2. Brian Cantor, Patrick Grant, Colin Johnston, "Automotive Engineering: Lightweight, Functional, and Novel Materials", CRC Press, Taylor & Francis Group, 2010.

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REFERENCES:

1. Geoffrey Davies, “Materials for Automobile Bodies”, Butterworth-Heinemann, 2012
2. Hiroshi Yamagata,” The Science and Technology of Materials in Automotive Engines”, Woodhead Publishing, 2005
3. Smallman R. E, Bishop R. J,” Modern Physical Metallurgy and Materials Engineering Science, process, applications”, Sixth Edition, Butterworth-Heinemann, 1999

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	2	2	2	2	2	2	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**3**	**3**	**2**

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AM3006	AUTOMOTIVE PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To introduce the importance of product design
2.	To understand the needs of a customer towards a product
3.	To initiate the idea of creativeness on product
4.	To understand the decision-making concepts.
5.	To design a product based on cost frame and need of the customer

UNIT I	**INTRODUCTION**	**9**

Need for developing products – product policy of an organization -the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design – designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products – establishing markets- market segments- relevance of market research- selection of a profitable product- concurrent engineering- reverse engineering

UNIT II	**CUSTOMER NEEDS**	**9**

Identifying customer needs –voice of customer –customer populations- hierarchy of human needs need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality- product design specification-case studies.

UNIT III	**CREATIVE THINKING AND PROTOTYPING**	**9**

Creative thinking methods- generating design concepts-systematic methods for designing – functional decomposition – physical decomposition functional representation –morphological methods-TRIZ- axiomatic design- computer aided design, DFX, DFM, DFA, ergonomics in product design, design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., - Prototyping, needs, advantages, working principle of SLA, LOM and SLS- value engineering in product design- Functional Analysis System Technique (FAST).

UNIT IV	**DECISION MAKING AND PRODUCT ARCHITECTURE**	**9**

Decision making –decision theory –utility theory –decision trees –concept evaluation methods – Pugh concept selection method- weighted decision matrix –analytic hierarchy process – introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture.

UNIT V	**DESIGN AND COST ANALYSIS**	**9**

Industrial design – human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost – overhead costs activity-based costing –methods of developing cost estimates – manufacturing cost –value analysis in costing.

TOTAL :	**45 PERIODS**

COURSE OUTCOMES:

CO1	Introduce the importance of product design
CO2	Understand the needs of a customer towards a product
CO3	Initiate the idea of creativeness on product
CO4	Understand the decision-making concepts.
CO5	Design a product based on cost frame and need of the customer.

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TEXT BOOKS:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9
2. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2015, Pearson Education, ISBN 9788177588217
3. David G. Ullman, "The Mechanical Design Process" – McGraw Hill, 2003

REFERENCES:

1. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7.
2. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9.
3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

AM3007	AUTOMOTIVE SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To introduce vehicle structural crashworthiness and crash testing
2.	To introduce Occupant safety system
3.	To get the knowledge in Active Safety in the vehicle and function of ADAS.
4.	To understand the fundamentals of sensor and to detect the obstacles around the vehicle and the concept of the connected vehicle.
5.	To Understand SAE Levels of Driving Automation.

UNIT I	**CONCEPTS OF AUTOMOTIVE SAFETY**	**9**

Automotive safety: Introduction and Types. Active safety: driving safety, conditional safety, Perceptibility safety, operating safety. Passive safety: Design of body for safety. Concept of crumble zone, Safety Cage. Optimum crash pulse, deceleration on impact with stationary and movable obstacles. Design for Crashworthiness. NCAP. ISO26262

UNIT II	**PASSIVE SAFETY EQUIPMENTS AND CONVENIENCE SYSTEM**	**9**

Seat belt, Seat belt tightener system and importance, collapsible steering column. Air bags and its activation. Designing aspects of automotive bumpers and materials for bumpers. Steering and mirror adjustment, central locking system, Tire pressure Monitoring system, rain sensor system, Automated wiper system.

UNIT III	**ACTIVE SAFETY**	**9**

Antilock braking system, Stability Control. Adaptive cruise control, Lane Keep Assist System, Collision warning, avoidance system, Blind Spot Detection system, Driver alertness detection System. ADAS.

UNIT IV	**VEHICLE INTEGRATION AND CONNECTED VEHICLE**	**9**

Looking out sensors and Looking in sensors, Intelligent vision system, Vehicle Integration system. Global Positioning System. Vehicle Navigation System. Road Network, V2V.

UNIT V	**AUTONOMOUS VEHICLE**	**9**

SAE Levels of Driving Automation, Level 0 – No Driving Automation, Level 1 – Driver Assistance, Level 2 – Partial Driving Automation, Level 3 – Conditional Driving Automation, Level 4 – High Driving Automation, Level 5 – Full Driving Automation.

TOTAL:	**45 PERIODS**

COURSE OUTCOMES:

CO1	Know about the concept of crumble zone and vehicle structural crashworthiness and crash testing
CO2	Know the various types of Occupant safety system
CO3	Know about Active Safety in the vehicle and avoid crash and function of ADAS.
CO4	Understand the fundamentals of sensor and to detect the obstacles around the vehicle and the concept of the connected vehicle.
CO5	Understand SAE Levels of Driving Automation.

TEXTBOOKS:

1. Ljubo Vlacic, Michel Parent, Fumio Harashima – “Intelligent Vehicle Technologies Theory and Applications” -Butterworth-Heinemann, 2001
2. J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori - “Sensors for Automotive Applications “ - WILEY-VCH Verlag GmbH & Co. 2003
3. Robert Bosch GmbH - “Safety, Comfort and Convenience Systems”- Wiley; 3rd edition 2007

REFERENCES:

1. Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.
2. J.Powloski - “Vehicle Body Engineering” - Business books limited, London - 1969.
3. Ronald.K.Jurgen - “Automotive Electronics Handbook” - Second edition- McGraw-Hill Inc., - 1999.
4. ARAI Safety standards

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	3	3	3	3	3	2
2	3	2	2	3	3	3	3	3	2
3	3	2	2	3	3	3	3	3	2
4	3	2	2	3	3	3	3	3	2
5	3	2	2	3	3	3	3	3	2
AVG	3	2	2	3	3	3	3	3	2

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AM3008	AUTONOMOUS AND CONNECTED VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	understanding of autonomous vehicles, including their classification, applications, advantages, and disadvantages.
2.	learn about decision-making principles and path planning techniques used in autonomous vehicles, exploring various approaches and verification/validation methods.
3.	To get the knowledge on sensors, perception, and visualization technologies, emphasizing sensor integration, AI algorithms, and neural networks.
4.	To understand about networking technologies and connected vehicles
5.	To understand human factors, ethical decision-making and the regulatory frameworks.

UNIT I	INTRODUCTION TO AUTONOMOUS VEHICLE TECHNOLOGY	9

Introduction - SAE autonomous Level Classification-Examples-Application of Autonomous Vehicle-Advantages and Disadvantages of Autonomous Vehicles.

UNIT II	PATH PLANNING AND DECISION MAKING	9

Principles of decision making and path planning for autonomous vehicles-Decision making approaches-Approximation-Heuristic-Graph Based-Point guidance. Verification and validation of decision making and path planning- Application examples of task allocation and path planning algorithms.

UNIT III	SENSORS, PERCEPTION AND VISUALISATION	9

Introduction to sensors, perception and visualization for autonomous vehicles-Sensor integration architectures and multiple sensor fusion-AI algorithms for sensing and imaging-neural networks.

UNIT IV	NETWORKING AND CONNECTED VEHICLES	9

Current and future vehicle networking technologies- CAN, LIN, MOST and Flex-ray. The use of modern validation and verification methods- software-in-the-loop, and hardware-in-the-loop techniques. The role of Functional Safety and ISO26262 within the overall control system. Inter-dependency between software engineering and control system-advanced test methods for the validation of safety-critical systems. connected vehicle control (CACC). Vehicle-to-everything (V2X), Applications such as intelligent traffic signals, collaborative adaptive cruise and vehicle platooning.

UNIT V	HUMAN FACTORS AND ETHICAL DECISION MAKING	9

Introduction to Human Factors-Human Performance: Perception and Attention-Situation Awareness and Error-Human Reliability: Driver Workload and Fatigue-Emotion and Motivation in Design-Trust in Autonomous Vehicles and Assistive Technology-Designing ADAS Systems-Driverless Vehicles and Ethical Dilemmas: Human Factors and Decision-Making Software-Application of Human Factors in Autonomous Vehicles. International and national regulatory frameworks for CAV and their safe operation

TOTAL:	**45 PERIODS**

COURSE OUTCOMES:

CO1	Demonstrate a comprehensive understanding of autonomous vehicle technology, including its classifications, applications, and associated advantages and disadvantages.
CO2	Apply decision-making principles and path planning techniques to design and implement algorithms for autonomous vehicles, utilizing various approaches and validation methods.
CO3	Analyze and integrate sensor data using appropriate architectures, AI algorithms, and neural networks for perception and visualization in autonomous vehicles.
CO4	Utilize networking technologies and communication protocols to enable connectivity in autonomous vehicles, while considering validation methods, functional safety, and the interdependencies between software engineering and control systems.

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CO5	Evaluate and address human factors considerations, such as human performance, workload, and ethical decision-making, within the design and operation of autonomous vehicles, while understanding the regulatory frameworks governing their safe deployment.

TEXT BOOKS:

1. Nicu Bizon, Lucian Dascalescu, Naser Mahdavi Tabatabaei, "Autonomous Vehicles: Intelligent Transport Systems and Smart Technologies,". Nova Science Publishers, 2014.
2. Andreas Herrmann, Walter Brenner, Rupert Stadler, “Autonomous Driving: How the Driverless Revolution will Change the World”, Emerald Publishing Limited ,2018.
3. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems” Springer, 2019.
4. Woodrow Barfield, Thomas A. Dingus,"Human Factors of Intelligent Transportation Systems”, Psychology Press,1997.

REFERENCES:

1. Nikolaus Correll, Bradley Hayes, et al., "Introduction to Autonomous Robots: From Kinematics to Path Planning,”, The MIT Press, 2022.
2. George Dimitrakopoulos, AggelosTsakanikas, Elias Panagiotopoulos,” Autonomous Vehicles: Technologies, Regulations, and Societal Impacts”, Elsevier, 2021.
3. Hod Lipson, Melba Kurman,” Driverless: Intelligent Cars and the Road Ahead”, MIT Press, 2016.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

AM3009	DESIGN AND ANALYSIS OF EXPERIMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To identify the key factors in designing experiments
2.	To develop appropriate experimental design
3.	To analyze the data to derive valid conclusions.
4.	To optimize process conditions by developing empirical models.
5.	To Design robust products and processes using parameter design approach.

UNIT I	**FUNDAMENTALS OF EXPERIMENTATION**	**9**

Role of experimentation in rapid scientific progress, Historical perspective of experimental approaches, Steps in experimentation, Principles of experimentation. Introduction to optimization techniques.

UNIT II	**SIMPLE COMPARATIVE EXPERIMENTS**	**9**

Basic concepts of probability and statistics, Comparison of two means and two variances, Comparison of multiple (more than two) means & ANOVA.

UNIT III	**EXPERIMENTAL DESIGNS**	**9**

Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data.

UNIT IV	**RESPONSE SURFACE METHODOLOGY**	**9**

Concept, linear model, steepest ascent, second order model, regression

UNIT V	**TAGUCHI'S PARAMETER DESIGN**	**9**

Concept of robustness, noise factors, objective function & S/N ratios, inner-array and outer- array design, data analysis

TOTAL:	**45 PERIODS**

COURSE OUTCOMES:

CO1	Formulate objective(s) and identify key factors in designing experiments for a given problem.
CO2	Develop appropriate experimental design to conduct experiments for a given problem.
CO3	Analyze experimental data to derive valid conclusions.
CO4	Optimize process conditions by developing empirical models using experimental data.
CO5	Design robust products and processes using parameter design approach.

REFERENCES:

1. Montgomery DC, Design and Analysis of Experiments, 7th Edition, John Wiley & Sons, NY, 2008.
2. Ross PJ, Taguchi Techniques for Quality Engineering, McGraw-Hill Book Company, NY, 2008.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

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AM3010	ENGINE COMBUSTION THERMODYNAMICS AND ENGINE HEAT TRANSFER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To remember and understand the thermodynamic principles of general and engine combustion.
2.	To apply the knowledge in chemical kinetics involved in general and engine combustion
3.	To understand different types of flames, their structures and analyze the factors affecting the flames.
4.	To evaluate the engine heat release rate and heat transfer models for engine combustion analysis.
5.	To evaluate the experimental methods on combustion and heat transfer calculations for engine analysis.

UNIT I	**INTRODUCTION TO COMBUSTION PROCESSES**	**9**

Definition for Fuel and Oxidizer – types – Various combustion modes- Combustion in premixed laminar and premixed turbulent combustion - Flame Speed – Burning Velocity - diffusion flames – Combustion process in IC engines.

UNIT II	**THERMODYNAMICS OF COMBUSTION**	**9**

Thermodynamics of combustion – Thermodynamic Properties – Ideal gas law – Gas mixture combustion – Stoichiometric combustion – Thermochemistry – Hess's law- Adiabatic flame temperature – Physics of combustion – Fick's law of species diffusion – Conservation equations – Boundary layer concept

UNIT III	**NORMAL, ABNORMAL COMBUSTION IN SI ENGINES**	**9**

Stages of combustion – Flame propagation –– Flame Limits – Flame Extinction - Rate of pressure rise – Cycle to cycle variation – Abnormal combustion – Theories of detonation – Effect of engine operating variables on combustion –Example problems.

UNIT IV	**COMBUSTION AND HEAT TRANSFER IN IC ENGINES**	**9**

Droplet and spray combustion theory – delay period – Peak pressure – Calculation of Heat release Rate – Gas temperature calculations – Diesel knock. Basic definitions – Convective heat transfer – Radiative heat transfer – Heat transfer, temperature distribution and thermal stresses in piston – Cylinder liner – Cylinder head – fins and valves.

UNIT V	**EXPERIMENTAL INVESTIGATION OF COMBUSTION AND HEAT TRANSFER IN IC ENGINES**	**9**

Photographic studies of combustion processes – Endoscopy Technique. P-θ diagrams in SI and CI engines, Post Processing for combustion parameters. Assembly – Temperature measurement in piston – cylinder liner – Cylinder head and engine valves.

TOTAL:	**45 PERIODS**

COURSE OUTCOMES:

CO1	Upon completion the students summarize the thermodynamic principles of general and engine combustion.
CO2	They understand the principle of engine combustion and the various heat transfer models and measuring methods of engine heat transfer in detail
CO3	They will have comment over on different flames and their importance in combustion applications
CO4	They will understand thermodynamics of combustion, grasp the knowledge of normal, abnormal combustion and heat transfer in engines
CO5	They also understand and apply the experimental techniques in investigating the combustion and heat transfer processes in IC engines

REFERENCES:

1. John. B. Heywood,' Internal Combustion Engines'", McGraw Hill Co., Newyork, 2017.
2. Spalding.D.B., "Some fundamental of Combustion", Butterworth Science Publications, London, 1985.
3. Taylor. E.F. "The Internal Combustion Engines ", International Text Book Co., Pennsylvania, 1982.
4. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2012.
5. Ashley Campbel, "Thermodynamic analysis of combustion engine", John book company, New york, 1979.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	2	3	2	3	3	3	2
2	3	3	2	3	2	3	3	3	2
3	3	3	2	3	2	3	3	3	2
4	3	3	2	3	2	3	3	3	2
5	3	3	2	3	2	3	3	3	2
AVG	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**

AM3011	FINITE ELEMENT METHODS IN AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To equip the students with the Finite Element Analysis fundamentals.
2.	To enable the students to formulate the design problems into FEA.
3.	To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions
4.	To understand the assembly of global arrays, and solution of the resulting algebraic systems.
5.	Understand how to use finite element analysis in engineering problems and application areas including stress, heat transfer, and vibration analysis

UNIT I **INTRODUCTION** **9**

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

UNIT II **1D ELEMENTS** **9**

Use of bar and beam elements in structural analysis. Bar Element – Stiffness matrix Formulation by direct and polynomial methods. Boundary condition and assemblage concepts. Beam element characteristics matrix. Global, local, natural coordinates.

UNIT III **2D ELEMENTS** **9**

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

UNIT IV **STRUCTURAL AND DYNAMIC ANALYSIS** **9**

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

UNIT V **HEAT TRANSFER ANALYSIS AND FLOW ANALYSIS** **9**

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1	Identify mathematical model for solution of common engineering problems.
CO2	Formulate simple problems into finite elements.
CO3	Solve structural, thermal, fluid flow problems.
CO4	Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
CO5	Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts

REFERENCES:

1. Segerlind,L.J., Applied Finite Element Analysis, Second Edition, John Wiley and Sons Inc.,New York, 1984
2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and applications of finite element analysis”, 4th edition, John Wiley & Sons, 2007.
3. Krishnamurthy,C.S., Finite Element Analysis, Tata McGraw Hill, 1987.

4. Ramamurthi,V., Computer Aided Design in Mechanical Engineering, Tata McGraw Hill,1987.
5. Bathe,K.J. and Wilson,E.L., Numerical methods in finite element analysis, Prentice Hall of India Ltd., 1983.
6. J. N. Reddy, “Finite Element Methods”, 2nd Edition, 6th Reprint, Tata McGraw Hill, 2005.
7. Singiresu S. Rao, “The Finite Elements Methods in Engineering”, 4th Edition, USA, 2005.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	2	3	2	3	3	3	2
2	3	3	2	3	2	3	3	3	2
3	3	3	2	3	2	3	3	3	2
4	3	3	2	3	2	3	3	3	2
5	3	3	2	3	2	3	3	3	2
AVG	3	3	2	3	2	3	3	3	2

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AM3012	HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To understand the basics of hydraulic and pneumatic systems
2.	To examine the working of hydraulic power drives
3.	To apply knowledge on fluid power elements
4.	To design hydraulic and pneumatic systems
5.	To apply the concepts of programming in PLC circuits.

UNIT I	INTRODUCTION	9

Properties - hydraulic fluids and air. Hydraulic fluids, types, factors affecting oil performance, governing principles and laws- distribution of fluid power- selection, power unit. Selection of pipe /tubing, couplings. Packing and seals, packing standards. Comparison between pneumatic and hydraulic system. energy losses in hydraulic systems- Symbols of pneumatic and hydraulic elements.

UNIT II	PNEUMATIC SYSTEMS	9

Basic requirement. Elements of pneumatics, preparation of compressed air. cooling and drying of compressed air. conditioning and distribution of compressed air. pneumatics actuators constructional details of air compressors, types, 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	9

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

UNIT IV	SERVO AND PLC SYSTEMS	9

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

UNIT V	AUTOMOTIVE APPLICATIONS	9

Hydraulic tipping mechanism, power steering, fork lift hydraulic gear, hydro-pneumatic suspension, air brake. Maintenance and trouble shooting. Design and analysis of a hydraulic /Pneumatic system-Case Study

	TOTAL:	45 PERIODS

COURSE OUTCOMES:

CO1	**Remember the importance of Fluid power**
CO2	Describe the use of various fluid power elements
CO3	Understand the concepts of various fluid power elements
CO4	Apply the knowledge on PLC and electro pneumatics
CO5	. Understand the various hydraulic circuits used in automobiles

TEXT BOOKS:

1. Anthony Esposito, “Fluid power with applications” , 5th Edition, Pearson Education 2003.
2. Majumdar, “Oil Hydraulics: Principles and Maintenance”, Tata McGraw Hill, 2004
3. Majumdar, “Pneumatic system: Principles and maintenance”, Tata McGraw Hill,2004

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REFERENCES:

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

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	2	2	2	3	3	2
2	3	2	2	2	2	2	3	3	2
3	3	2	2	2	2	2	3	3	2
4	3	2	2	2	2	2	3	3	2
5	3	2	2	2	2	2	3	3	2
AVG	3	2	2	2	2	2	3	3	2

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AM3013	IC ENGINE PROCESS MODELLING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To impart knowledge in modeling the Internal combustion engine processes and acquire knowledge in different types of engine models and their importance
2.	To understand the calculation of heat of reaction, air fuel ratio and flame temperature for developing a thermodynamic engine model.
3.	To acquire knowledge on the detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation of SI engine.
4.	To understand the gas exchange process and develop models for the intake and exhaust processes.
5.	To develop a complete theoretical engine model for the SI engine and differentiate the model from CI engine model.

UNIT I	**INTRODUCTION TO SIMULATION**	9

Introduction to Simulation, 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. Overview of modelling softwares.

UNIT II	**STOICHIOMETRY AND ADIABATIC FLAME TEMPERATURE**	9

Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air, excess air and stoichiometric air required for combustion. 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	**SI ENGINE SIMULATION**	9

SI Engine simulation with air as working medium, deviation between actual and ideal cycle. Fuel air cycle analysis - Temperature drop due to fuel vaporization, full throttle operation, work output and efficiency calculation, part-throttle operation, engine performance at part throttle, super charged operation. SI Engines simulation with progressive combustion. Models for mass burnt fraction.

UNIT IV	**SI ENGINE SIMULATION WITH GAS EXCHANGE PROCESS**	**9**

Introduction, gas exchange process, Heat transfer process, friction calculations, comparison 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 and analysis of the data. Case study using engine simulation Software. Overview of CFD modelling.

UNIT V	**ENGINE SIMULATION FOR CI AND ADVANCED ENGINES**	**9**

Zero, one and multizone models for diesel engine combustion. Wiebe's Model, Whitehouse model and Watson model for diesel combustion. Heat release rate and heat transfer models. Equilibrium calculations. Engine modeling for dual fuel engine- Multifuel engines. Programming of the modeling process and validation of the models. Parametric studies on simulated engine performance.

TOTAL:	**45**

COURSE OUTCOMES:

CO1	understand the classifications and applications of engine cycle simulation model and grasp the major modeling and simulation methods and the influence of model parameters on engine performance.
CO2	Analyze the heat of reaction, fuel air ratio and flame temperature for developing a thermodynamic engine model
CO3	Evaluate the air standard, fuel air cycle, progressive and actual cycle simulation of SI engine.
CO4	Evaluate the gas exchange processes and be able to build the control-oriented simulation model of internal combustion engines

CO5	Create engine models for SI and CI engines and also can create models for advanced engine concepts

REFERENCES:

1. Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley & Sons, New York, 1986.
2. Benson.R.S., Whitehouse.N.D., "Internal Combustion Engines", Pergamon Press, oxford, 1979
3. Ganesan.V. "Computer Simulation of spark ignition engine process", Universities Press (I) Ltd, Hyderbad, 1996.
4. John. B. Heywood, 'Internal Combustion Engines'", Tata McGraw Hill Co., Newyork, 2017.
5. Ramoss.A.L., "Modelling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	2	3	2	2	3	3	2
2	3	3	2	3	2	2	3	3	2
3	3	3	2	3	2	2	3	3	2
4	3	3	2	3	2	2	3	3	2
5	3	3	2	3	2	2	3	3	2
AVG	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**

AM3014	INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To Study the theory, construction and operation of different measurement technology for automobiles
2.	To understand working principle of various instruments, transducers and their application in automotive industry.
3.	To acquire knowledge on various mechanical measurement instruments techniques
4.	To study different types of instruments used for engine testing and its working principle
5.	To acquire knowledge in experimental methods for testing the vehicle with different instruments

UNIT I	**MEASUREMENT SYSTEMS**	**9**

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

UNIT II	**TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES**	**9**

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

UNIT III	**MECHANICAL MEASUREMENT**	**9**

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

UNIT IV	**ENGINE EXPERIMENTAL TECHNIQUES**	**9**

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

UNIT V	**VEHICLE EXPERIMENTAL TECHNIQUES**	**9**

Laboratory tests- test tracks - Endurance Tests- crash tests- Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations. Impact test – Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements.

	TOTAL:	**45**

COURSE OUTCOMES:

The students will be able to

CO1	Interpret the components of the automotive instruments and their functions and the latest developments in this field.
CO2	Demonstrate their knowledge on transducers, modifiers and terminating devices
CO3	Understand mechanical measurement
CO4	Experiment the various procedure followed in the engine experimental techniques
CO5	Demonstrate their understanding of the vehicle experimental techniques.

TEXTBOOKS:

1. Crouse W H and Anglin D L., “Automotive Mechanics” Tata McGraw Hill Publishing Company, 2004.
2. J.G. Giles, ‘Engine and Vehicle Testing’, Illiffe books Ltd., London,1988.
3. Richard D. Atkins, An Introduction to Engine Testing and Development, SAE International 2009.
4. W. Judge, ‘Engineering Precision Measurement’, Chapman and Hall Ltd, Essex StreetW.C.,1951,

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REFERENCES:

1. Rangan, Sharma and Mani, 'Instrumentation Devices and systems', Tata McGraw Hill Publishing Co., Ltd., 1990
2. T.G. Beckwith and Buck, 'Mechanical Measurements', Oxford and IBH Publishing House, NewDelhi, 1995
3. D.Patambis, 'Principle of Industrial Instrumentation', Tata McGraw Hill Publishing Co, New Delhi,1990.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	3	3	3	3	3	2
2	3	2	2	3	3	3	3	3	2
3	3	2	2	3	3	3	3	3	2
4	3	2	2	3	3	3	3	3	2
5	3	2	2	3	3	3	3	3	2
AVG	3	2	2	3	3	3	3	3	2

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AM3015	INTELLIGENT TRANSPORT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To describe the digital map database module
2.	To describe the working of the positioning module.
3.	To describe the working of the direction module
4.	To describe the working of wireless communication module.
5.	To describe the working of autonomous location and navigation module.

UNIT I	**DIGITAL MAP DATABASE MODULE**	**9**

Introduction to Modern Vehicle Location and Navigation - Basic Representations - Reference Coordinate Systems – Standards - Proprietary Digital Map Databases - Digital Map Compilation.

UNIT II	**POSITIONING MODULE**	**9**

Introduction-Dead Reckoning-Global Positioning System - Sensor fusion - Conventional map matching - Fuzzy logic Based Map matching - Other Map matching algorithms - Map aided Sensor calibration.

UNIT III	**DIRECTION MODULE**	**9**

Shortest Path - Heuristic Search - Bidirectional Search - Hierarchical search - other algorithms - Guidance while En Route - Guidance while off Route - Guidance with dynamic information.

UNIT IV	**WIRELESS COMMUNICATION MODULE**	**9**

Introduction - Communication Subsystem Attributes - Existing Communication Technologies - Communication Subsystem Integration.

UNIT V	**AUTONOMOUS LOCATION AND NAVIGATION**	**9**

Introduction – Vehicle Location: Standalone Technologies - Radio Technologies - Satellite Technologies - Vehicle Navigation: Coping with complex requirements - Dual use navigation and entertainment components - Centralized location and Navigation Introduction - Automatic Vehicle Location: Centralized and Distributed Approach- Dynamic Navigation: Centralized and Distributed.

	TOTAL :	**45**

COURSE OUTCOMES:

The students will be able to

CO1	the digital map database module
CO2	the working of the positioning module.
CO3	the working of the direction module
CO4	the working of wireless communication module.
CO5	the working of autonomous location and navigation module

REFERENCES:

1. "Intelligent Vehicle Technologies Theory and Applications"– L Vlacic- M Parent- F Harashima- Butterworth Heinemann
2. "Vehicle location and Navigation Systems" – Yilin Zhao – Artech House Inc.
3. Sussman Joseph- "Perspectives on Intelligent Transportation Systems (ITS)"- New York- NY: Springer- 2010.
4. Mashrur A. Chowdhury- and Adel Sadek- "Fundamentals of Intelligent Transportation Systems Planning"- Artech House- Inc.- 2003.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	1	2	3	3	3	3	3	2
2	3	1	2	3	3	3	3	3	2
3	3	1	2	3	3	3	3	3	2
4	3	1	2	3	3	3	3	3	2
5	3	1	2	3	3	3	3	3	2
AVG	**3**	**1**	**2**	**3**	**3**	**3**	**3**	**3**	**2**

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AM3016	MOTORSPORT TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	Understand the principles and challenges of race car design and development, including rulebook compliance, performance requirements, and safety considerations.
2.	Apply aerodynamic principles to optimize race car performance and analyze the effectiveness of aerodynamic devices in cornering and drag reduction.
3.	Analyze and optimize race car chassis design and tuning to enhance handling, weight distribution, and driver safety.
4.	Evaluate and optimize race car suspension systems to achieve stability, traction, and precise control during various racing maneuvers.
5.	Assess and optimize race car drive systems and braking systems to achieve optimal power transfer, control, and braking performance on the track.

UNIT I	**RACE CAR DESIGN AND DEVELOPMENT**	**9**

Problems Imposed by Racing and Racing Objectives. Rulebook, Regulations, and Constraints. Road Car vs Race Car Comparison. Performance and Handling Specifications. Structure, Weight Distribution, and Driver Safety. Tire and Adjustable Features. Preliminary Design and Analysis. Driver-Vehicle Relationship and Desirable Characteristics. Case Studies

UNIT II	**RACE CAR AERODYNAMICS**	**9**

Aerodynamic Forces and Moments. Race Car Drag Components and Estimation. Ground Effects and Ground Plane Simulation. Spoilers, Wings, and Effectiveness in Cornering. Flow Control Devices and Vortex Creation. Pressure Change Creation Devices. Full Size Wind Tunnel Testing. Case Studies: Chaparral Wings, Formula Benetton's Wind Tunnel.

UNIT III	**RACE CAR CHASSIS**	**9**

Conditions for Cornering and Chassis Tuning. Effects of High-Speed Braking, Cornering, and Combined Actions. Steady State Cornering and Acceleration. Straight Line Acceleration and Throttle Behavior. Moving CG Position and Roll Center. Anti-Pitch Geometry and Chassis Steering Axis. Chassis Ride Roll Characteristics and Track Width. Tires, Rims, and Roll Stiffness Adjustment. Case Studies: Monocoque Chassis Development, Carbon Fiber.

UNIT IV	**RACE CAR SUSPENSION SYSTEM**	**9**

Front Suspension Design and Performance Features. Camber Effects and McPherson Struts. SLA Suspension and Rear Suspension Types.F1 Car Suspension Configurations. Suspension Springs and Installation Considerations. Damping in Racing and Ride/Handling Compromise. Steering Activity and Bump/Rebound Damping. Chassis Track Width and Ride Spring Rate. Adjusting Roll Stiffness Distribution

UNIT V	**RACE CAR DRIVES AND BRAKING SYSTEMS**	**9**

Front and Rear-Wheel Drive in Racing. Four-Wheel Drive and Differentials in Racing. Limited Slip Differential and Traction Control. Mechanical Components in Braking System. Limitations and Considerations of Braking in Racing. Brake Boost and Effects of "g" Force. Brake Hydraulics, Ventilation, and Distribution. ABS in Racing and Carbon-Carbon Discs. Case Study

	TOTAL:	**45**

COURSE OUTCOMES:

The students will be able to

CO1	Understand the unique challenges and objectives in racing, including rulebook compliance, performance requirements, and design considerations.
CO2	Apply principles of aerodynamics, including the use of spoilers, wings, and flow control devices, to optimize race car performance and cornering capabilities.
CO3	Analyze and optimize race car chassis design and tuning, considering factors such as weight distribution, suspension systems, and handling characteristics.
CO4	Evaluate and optimize race car suspension systems to enhance stability, traction, and overall handling performance.
CO5	Assess and optimize race car drive systems and braking systems to achieve optimal performance, control, and safety on the track.

REFERENCES:

1. Adrian Newey, "How to Build a Car: The Autobiography of the World's Greatest Formula 1 Designer," HarperCollins, 2017.
2. Simon McBeath, "Competition Car Aerodynamics: A Practical Handbook," Haynes Publishing, 2014.
3. Brian Beckman, "Vehicle Dynamics: Theory and Application," Society of Automotive Engineers (SAE) International, 2013.
4. John Dixon, "Competition Car Composites: A Practical Handbook," Haynes Publishing, 2013.
5. Michael Costin and David Phipps, "Competition Car Chassis: Design, Structures, and Materials," Haynes Publishing, 2008.
6. Allan Staniforth, "Competition Car Suspension: Design, Construction, Tuning," Haynes Publishing, 2005.
7. David E. Hoyle, "ISO 9000 Quality Systems Handbook: Automotive Industry Edition," Butterworth-Heinemann, 2005.
8. Paul Van Valkenburgh, "Race Car Engineering & Mechanics," Bentley Publishers, 2001.
9. William F. Milliken and Douglas L. Milliken, "Race Car Vehicle Dynamics," SAE International, 1995.
10. Carroll Smith, "Tune to Win: The art and science of race car development and tuning," Aero Publishers, 1978.

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	3	3	3	3	3	2
2	3	2	2	3	3	3	3	3	2
3	3	2	2	3	3	3	3	3	2
4	3	2	2	3	3	3	3	3	2
5	3	2	2	3	3	3	3	3	2
AVG	3	2	2	3	3	3	3	3	2

AM3017	NOISE, VIBRATION AND HARSHNESS FOR AUTOMOBILES.	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	Understand the various types of vibration with damping and without damping.
2.	Understand the Various types of noise and its measurement and analysis techniques.
3.	Understand the various sources of noise from IC engine.
4.	Understand the various noise controlling techniques from automobiles.
5.	Understand the various noise from mechanical components and it's suppressing techniques.

UNIT I	FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION	9

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping

UNIT II	EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK ON PEOPLE	9

General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.

UNIT III	ENGINE NOISE AND VIBRATION—SOURCES, PREDICTION, AND CONTROL	9

Introduction to Engine Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers.

UNIT IV	TRANSPORTATION NOISE AND VIBRATION SOURCES-PREDICTION AND CONTROL	9

Introduction to Transportation Noise and Vibration Sources, Tire/Road Noise—Generation, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

UNIT V	NOISE AND VIBRATION TRANSDUCERS, ANALYSIS, SIGNAL PROCESSING, AND MEASURING TECHNIQUES	9

General Introduction to Noise and Vibration Transducers, Measuring Equipment, Noise and Vibration Measurements, Signal Acquisition, and Processing. Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, Equipment for Data Acquisition, Determination of Sound Power Level and Emission, Sound Intensity Measurements, Noise and Vibration Data Analysis, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Traceability of Vibration and Shock Measurements.

TOTAL :	**45 Periods**

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COURSE OUTCOMES: At the end of the course, the student will be able to	
CO1	Classify the types of vibrations.
CO2	Understand the effect of vibrations and noises.
CO3	Identify the sources of noise in IC engines and how to control it.
CO4	Control vibration and noise with suitable techniques for Transportation.
CO5	Apply engineering techniques and tools for NVH measurements.

TEXT BOOKS:

1. McConnell K, "Vibration Testing Theory and Practice", John Wiley, 1995.
2. Norton M P, Fundamental of Noise and Vibration, Cambridge University Press,1989

REFERENCES:

1. Allan G. Piersol, Thomas L. Paez "Harris' shock and vibration hand book", McGraw-Hill , New Delhi, 2010
2. Clarence W. de Silva, "Vibration Monitoring, Testing, and Instrumentation ",CRC Press, 2007
3. David A.Bies and Colin H.Hansen "Engineering Noise Control: Theory and Practice " Spon Press , London . *2009*
4. Colin H Hansen "Understanding Active Noise Cancellation " , Spon Press , London .2003
5. Matthew Harrison "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles ", Elsevier Butterworth-2004

COs	POs						PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1	3	2	2	3	3	3	3	3	2
2	3	2	2	3	3	3	3	3	2
3	3	2	2	3	3	3	3	3	2
4	3	2	2	3	3	3	3	3	2
5	3	2	2	3	3	3	3	3	2
AVG	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**

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AM3018	PRODUCTION OF AUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To import knowledge on
2.	To compare and analyze the different casting process
3.	To design various machining process according to the requirement
4.	Analysis of suitable process related to forming
5.	To differentiate the effect of powder metallurgy on selective components

UNIT I	CASTING	9

Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of pistons, pressure die casting of carburetor other small auto parts. Investment casting of turbine and compressor blades of turbo charge. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores – Copy turning and profile grinding machines. Melting practice of alloys.

UNIT II	MACHINING	9

Special consideration of machining of various components such as flywheel, piston rings, bearing bushes, and liners, permanent mould casting of pistons. 5-axis milling for complex shaped components - turbine and compressor wheels.

UNIT III	FORGING AND EXTRUSION PROCESS	9

Forging materials - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, steering column. Extrusions: Basic process steps, extrusion of transmission shaft, housing spindle, steering worm blanks, piston pin and valve tappets. Hydro forming - Process, hydro forming of manifold and comparison with conventional methods- Hydro forming of tail lamp housing – forming of wheel disc and rims. Stretch forming - Process, stretch forming of auto body panels –Super plastic alloys for auto body panels

UNIT IV	POWDER METALLURGY AND PROCESSING OF PLASTICS	9

Powder metallurgy process, process variables, Manufacture of friction lining materials for clutches and brakes – plastics-raw material –automobile components – molding – injection, compression and blow – PU foam molding - Machining of plastics. Plastic welding, optical parts manufacturing process.

UNIT V	RECENT TRENDS IN MANUFACTURING OF AUTOMOBILE COMPONENTS	9

Powder injection molding - Production of aluminum MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming – Squeeze Casting of pistons - aluminum composite brake rotors. Sinter diffusion bonded idler sprocket – gas injection molding of window channel – cast con process for auto parts. Rapid Prototyping Technologies: Additive manufacturing of Plastics & metals.

TOTAL: 45

COURSE OUTCOMES:

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

CO1	Identify the methods to manufacture the vehicle components
CO2	Analyze the requirements of each component and material
CO3	Differentiate between the casting and forming process
CO4	Design the process for manufacturing vehicle components
CO5	Understand the advanced techniques used for manufacturing Automobile components

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REFERENCES:

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

COs	POs						PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1	3	2	3	3	3	3	3	3	2
2	3	2	3	3	3	3	3	3	2
3	3	2	3	3	3	3	3	3	2
4	3	2	3	3	3	3	3	3	2
5	3	2	3	3	3	3	3	3	2
AVG	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

AM3019	REVERSE ENGINEERING IN AUTOMOBILE ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

To import knowledge on

1.	fundamental concepts and principles of reverse engineering in product design and development.
2.	concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3.	the concept and principles of material identification and process verification in reverse engineering of product design and development.
4.	the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
5.	Analyzing the various legal aspect and applications of reverse engineering in product design and development.

UNIT I	**INTRODUCTION TO REVERSE ENGINEERING**	**12**

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

UNIT II	**MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION**	**12**

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure.

UNIT III	**MATERIAL IDENTIFICATION AND PROCESS VERIFICATION**	**12**

Material Specification - Composition Determination - Microstructure Analysis – Manufacturing Process Verification.

UNIT IV	**DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY**	**12**

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.

UNIT V	**ACCEPTANCE AND LEGALITY OF RE**	**12**

Legality of Reverse Engineering – Patent – Copyrights –Trade Secret – Third-Party Materials

PRACTICALS

1. Prepare a function and product structure of an automotive component
2. Freehand sketch of assembly and parts
3. Prepare part interface matrix
4. Prepare manufacturing drawing for assembly and parts
5. Prepare a prototype using 3D Printing / machining

TOTAL :	**60 PERIODS**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1	Apply the fundamental concepts and principles of reverse engineering in product design and development.
CO2	Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
CO3	Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
CO4	Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.

CO5	Analyze the various legal aspect and applications of reverse engineering in product design and development.

TEXT BOOKS:

1. Wego Wang, “Reverse Engineering Technology of Reinvention”, CRC Press, 2011.
2. Vinesh Raj and Kiran Fernandes, “Reverse Engineering: An Industrial Perspective”, Springer- Verlag London Limited 2008.

REFERENCES:

1. Kathryn, A. Ingle, “Reverse Engineering”, McGraw-Hill, 1994.
2. Linda Wills, “Reverse Engineering”, Kluver Academic Publishers, 1996
3. Donald R. Honsa, “Co-ordinate Measurement and Reverse Engineering”, American Gear Manufacturers Association.

COs	POs						PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1	3	2	2	2	2	2	3	3	2
2	3	2	2	2	2	2	3	3	2
3	3	2	2	2	2	2	3	3	2
4	3	2	2	2	2	2	3	3	2
5	3	2	2	2	2	2	3	3	2
AVG	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**

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AM3020	SPECIAL PURPOSE VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To enhance the knowledge of the students about the various equipment's used in earthmoving, applications.
2.	To understand the construction and working of the vehicle for constructional application
3.	To describe the working nature of farm equipment's based on their application.
4.	To discriminate the various industrial vehicles based on the purpose.
5.	To acquire the knowledge on the functioning of military vehicle.

UNIT I	**EARTH MOVING EQUIPMENTS**	**9**

Construction layout, capacity and applications of dumpers, articulated haulers, front- end loaders, backhoe loaders, bulldozers, scrappers, motor graders, skid-steer loaders, excavator, hydraulic shovels, bucket conveyors, surface miners– highwall Miners. Selection criteria of prime mover for dumpers.

UNIT II	**CONSTRUCTIONAL EQUIPMENTS**	**9**

Construction layout, capacity and applications of cranes–types, Articulated Trucks, concrete ready mixer, trenchers, Asphalt Pavers, road reclaimers, Compactors– types, draglines, drillers, bore well machine.

UNIT III	**FARM EQUIPMEMTS**	**9**

Classification of tractors – Main components of tractor. Working attachment of tractors – Auxiliary equipment –-Top lifting harvesters. General description, working, specification and functions paddy harvesting machines, Sugarcane harvesting, feller bunchers, forest machines.

UNIT IV	**INDUSTRIAL VEHICLES**	**9**

Constructional features, capacity and working of forklifts, Utility vehicles, towing vehicles, man-lift chassis, scissor lift trucks, material handlers, reclaimers, Street sweepers.

UNIT V	**MILITARYANDCOMBATVEHICLES**	**9**

Special features and constructional details of Main Battle tank, gun carriers, transport vehicles, Armored vehicle – launched bridge, amphibious bridging vehicle, communication vehicles.

TOTAL:	**45**

COURSE OUTCOMES:

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

CO1	Demonstrate their understanding about the operation of the various special purpose vehicle
CO2	Understand the construction layout of earthmoving equipment's.
CO3	Have the ability to apply the knowledge to design a new concept for construction application.
CO4	Demonstrate their skill in developing modern techniques for future farming vehicles
CO5	Distinguish the various military vehicles and infer their particular technology.

REFERENCES:

1. Abrosimov.K, Branberg.A.and Katayer.K., "Road making Machinery", MIR Publishers, Moscow,1971.
2. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers,1987.
3. Wong.J.T, "Theory of Ground vehicles ", John Wiley &Sons, NewYork,1987.
4. B.Geleman and M.Moskovin, "Farm tractors" ,MIR publishers, Moscow.
5. Bart H Vanderveen, "Tanks and Transport vehicles", Frederic Warne and Co ltd., London.
6. Kolchin,A. and V.Demidov," Design of Automotive Engines for Tractor" , MIR Publishers, 1972.
7. Peurifoy R.L, "Construction Planning, Equipment and Methods",Tata McGraw-Hill, New Delhi,2002.
8. WongJ"Terramechanics and Off-Road Vehicle Engineering",Butterworth-Heinemann, 2009

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COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	2	2	2	3	3	2
2	3	2	2	2	2	2	3	3	2
3	3	2	2	2	2	2	3	3	2
4	3	2	2	2	2	2	3	3	2
5	3	2	2	2	2	2	3	3	2
AVG	3	2	2	2	2	2	3	3	2

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AM3021	THEORY OF FUELS AND LUBRICANTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To identify the processes behind fuel extraction system.
2.	To understand the theory behind lubrication.
3.	To study the properties of lubricants.
4.	To elaborate the properties of fuels used in IC engines.
5.	To understand the need of fuel rating.

UNIT I	**MANUFACTURE OF FUELS AND LUBRICANTS**	**9**

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

UNIT II	**THEORY OF LUBRICATION**	**9**

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

UNIT III	**PROPERTIES AND TESTING OF LUBRICANTS**	**9**

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

UNIT IV	**PROPERTIES AND TESTING OF FUELS AND COMBUSTION**	**9**

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

UNIT V	**ADDITIVES FOR LUBRICANTS AND FUELS**	**9**

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

TOTAL :	**45 PERIODS**

COURSE OUTCOMES: At the end of this course the student should be able to

CO1	Identify the processes behind fuel extraction system.
CO2	Understand the theory behind lubrication
CO3	Study the properties of lubricants.
CO4	Elaborate the properties of fuels used in IC engines.
CO5	Understand the need of fuel rating.

TEXT BOOKS:

1. Ganesan. V., “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co., New Delhi, 2017.
2. M.L. Mathur, R.P.Sharma “A course in internal combustion engines”, Dhanpatrai publication, 2003.
3. A.R.Lansdown,” Lubrication – A practical guide to lubricant selection”, Pergamon press – 1982.

REFERENCES:

1. Raymond.C.Gunther, “Lubrication”, Chilton Book Co., - 1971.
2. Brame, J.S.S. and King, J.G.,”Fuels – Solids, Liquids, Gaseous”
3. Francis, W., “Fuels and Fuel Technology, Vol. I & II”, Hobson, G.D. & Pohl.W- Modern Petroleum Technology

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	2	2	2	3	3	2
2	3	2	2	2	2	2	3	3	2
3	3	2	2	2	2	2	3	3	2
4	3	2	2	2	2	2	3	3	2
5	3	2	2	2	2	2	3	3	2
AVG	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**

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AM3022	TWO AND THREE WHEELERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to make the students to

1.	Impart the knowledge on two-wheeler design and stability aspects
2.	Understand the construction and working of power unit in two and three-wheeler & Expose knowledge on different ignition systems and electrical systems.
3.	Gain knowledge on clutch and transmission system of two wheelers
4.	Recognize various frames used in two wheelers and to gain knowledge on two-wheeler suspension & brake systems.
5.	Identify and interpret various three wheelers for different applications

UNIT I	**INTRODUCTION**	**9**

Classifications of different two wheelers based on usage – Layout of different two wheelers - design considerations – weight and dimension limitations –requirements, stability problems, gyroscopic effect- pendulum effect of two and three wheelers. Problems on gyroscope

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

Two stroke and four stroke engines. Single, twin and multi cylinder engines. Air cooled and liquid cooled engines. Carburetted engines, Sensors in fuel supply system, PFI, MPFI and GDI engines. Battery coil ignition, magneto ignition and electronic ignition. Lighting and other electrical systems. Selection of engines for two wheelers

UNIT III	**STEERING, CLUTCHES AND TRANSMISSION**	**9**

Steering Geometry and Effects – Steering Column for Two wheelers, Layout of transmission system in two-wheeler. Clutch - Single and multi plate clutch, Assist Slipper clutch, Centrifugal Clutch- design of clutch. Gear boxes. Gear change mechanism. CVT. Freewheeling devices. Starting Mechanisms – Kick & Electrical start mechanism. Final drives - Belt, chain and shaft drive.

UNIT IV	**FRAMES, SUSPENSION, WHEELS, TYRES AND BRAKES**	**9**

Types of frames. Design of frames for fatigue strength, torsional stiffness and lateral stability. Front and rear forks. Telescopic Suspension system - Dampers, Design consideration for suspension systems. Constructional details of wheel and tyres. Braking systems Drum and Disc Brakes. Anti Lock Braking system.

UNIT V	**THREE WHEELERS**	**9**

Auto rickshaws, different types, Pick-Ups and delivery type vehicle, frames and transmission, Swing arm suspension systems. Wheel types – Spoke, Pressed steel, Alloy. Tyre – Cross and Radial Ply Tires. Brake systems. Introduction about electric and two and three wheelers

	TOTAL	**45**

COURSE OUTCOMES:

On successful completion of this course students will be able to:

CO1	Demonstrate and design the two-wheeler and stability.
CO2	Identify and distinguish various two-wheeler power unit functions and Ignition systems
CO3	Demonstrate various design aspects of clutch and transmission system for two and three wheelers
CO4	Describe and identify the different two wheelers frames and its sub systems for different applications
CO5	Explain and distinguish the different three wheelers and its sub systems based on applications

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TEXT BOOKS:

1. Edward Abdo, Modern motor cycle technology by 3rd Edition, 2015
2. Irving,P.E., Motor cycle Engineering, Temple Press Book, London, 1992.

REFERENCES:

1. K. K. Ramalingam, Two Wheelers, Scitech publications, Chennai
2. Motorcycle Basics Tech book by Haynes 2nd Edition, 2015
3. Motorcycle mechanics, By George Lear,1977
4. Motorcycle Owner's Manual By Hugo Wilson 1997
5. The Essential Guide to Motorcycle Maintenance By Mark Zimmerman2016
3. Two and Three Wheeler Technology, Dhruv U.Panchal, PHI Learning, 2015

COs	POs						PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
1	3	2	2	2	2	2	3	3	2
2	3	2	2	2	2	2	3	3	2
3	3	2	2	2	2	2	3	3	2
4	3	2	2	2	2	2	3	3	2
5	3	2	2	2	2	2	3	3	2
AVG	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**

AM3023	VEHICLE AIR CONDITIONING SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to make the students to

1.	To solve the simple problems related to psychrometry and refrigerant.
2.	To understand the operation of the individual components of the A/System, sensors, actuators and electronic control.
3.	To understand the range of techniques that can be used in diagnosing
4.	To identify faults which affect system performance.
5.	To provide adequate knowledge in safe working practice. Understanding the correct procedures for A/C service and repair.

UNIT I	AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS	9

Purposes of Heating, Ventilation and Air Conditioning- Environmental Concerns- Ozone layer depletion- Location of air conditioning components in a car – Schematic layout of a vehicle refrigeration system. Psychrometry – Basic terminology and Psychrometric Mixtures- Psychrometric Chart- Related problems.

UNIT II	AUTOMOTIVE COOLING AND HEATING SYSTEM	9

Vehicle Refrigeration System and related problems- Fixed thermostatic and Orifice tube system- Variable displacement thermostatic and Orifice tube system- Vehicle air conditioning operation Types of compressor- Compressor Clutches- Compressor Clutch electrical circuit- Compressor lubrication- Condensers- Evaporators- Expansion devices- Evaporator temperature and pressure controls- receiver-drier- Accumulators- refrigerant hoses, Connections and other assemblies- Heating system.

UNIT III	AIR-CONDITIOING CONTROLS, DELIVERY SYSTEM AND REFRIGERANTS	9

Types of Control devices- Preventing Compressor damage- Preventing damage to other systems- Maintaining drive ability- Preventing Overheating Ram air ventilation- Air Delivery Components- Control devices- Vacuum Controls Containers – Handling refrigerants – Discharging, Charging & Leak detection – Refrigeration system diagnosis – Diagnostic procedure- Ambient conditions affecting system pressures.

UNIT IV	AUTOMATIC TEMPERATURE CONTROL	9

Different types of sensors and actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

UNIT V	SYSTEM SERVICING AND TESTING	9

Special tools for servicing vehicle air conditioning – Diagnosing components and air conditioning systems- Diagnosing cooling system- Air delivery system- Automatic Temperature Control system diagnosis and service.

	TOTAL	45

COURSE OUTCOMES:

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

CO1	Solve the simple problems related to psychrometry and refrigerant
CO2	Understand the operation of the individual components of the A/System, sensors, actuators and electronic control
CO3	Understand the range of techniques that can be used in diagnosing
CO4	Identify faults which affect system performance
CO5	Provide adequate knowledge in safe working practice. Understanding the correct procedures for A/C service and repair

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TEXT BOOKS:

1. Warren Farnell and James D. Halderman, Automotive Heating, Ventilation, and Air Conditioning systems, Classroom Manual, Pearson Prentice Hall,2004
2. William H Crouse and Donald L Anglin, Automotive Air conditioning, McGraw Hill Inc.,1990.

REFERENCES:

1. Goings, L.F., Automotive Air Conditioning, American Technical services, 1974.
2. McDonald, K.L., Automotive Air Conditioning, Theodore Audel series, 1978.
3. Mitchell Information Services, Inc., Mitchell Automatic Heating and Air Conditioning Systems, Prentice Hall Inc., 1989.
4. Paul Weisler, Automotive Air Conditioning, Reston Publishing Co. Inc., 1990

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	2	2	2	2	2	3	3	2
2	3	2	2	2	2	2	3	3	2
3	3	2	2	2	2	2	3	3	2
4	3	2	2	2	2	2	3	3	2
5	3	2	2	2	2	2	3	3	2
AVG	3	2	2	2	2	2	3	3	2

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AM3024	VEHICLE EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.	To expose the students to the fundamentals and building of Electronic Engine Control systems.
2.	To teach on functional components and circuits for vehicles.
3.	To discuss on programmable controllers for vehicles management systems.
4.	To teach logics of automation & commercial techniques for vehicle communication.
5.	To introduce the embedded systems concepts for E-vehicle system development

UNIT I	**BASIC OF ELECTRONIC ENGINE CONTROL SYSTEMS**	**9**

Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Automotive microcontrollers- Electronic control Unit- Hardware & software selection and requirements for Automotive applications – open source ECU- RTOS - Concept for Engine Management-Standards; Introduction to AUTOSAR and Introduction to Society SAE- Functional safety ISO 26262- Simulation and modelling of automotive system components.

UNIT II	**SENSORS AND ACTUATORS FOR AUTOMOTIVES**	**9**

Review of sensors- sensors interface to the ECU, conventional sensors and actuators, Modern sensor and actuators - LIDAR sensor- smart sensors- MEMS/NEMS sensors and actuators for automotive applications.

UNIT III	**VEHICLE MANAGEMENT SYSTEMS**	**9**

Electronic Engine Control-engine mapping, air/fuel ratio spark timing control strategy, fuel control, electronic ignition- Adaptive cruise control - speed control-anti-locking braking system-electronic suspension - electronic steering, Automatic wiper control- body control system; Vehicle system schematic for interfacing with EMS, ECU. Energy Management system for electric vehicles- Battery management system, power management system-electrically assisted power steering system- Adaptive lighting system- Safety and Collision Avoidance.

UNIT IV	**ONBOARD DIAGONSTICS AND TELEMATICS**	**9**

On board diagnosis of vehicles -System diagnostic standards and regulation requirements Vehicle communication protocols Bluetooth, CAN, LIN, FLEXRAY, MOST, KWP2000 and recent trends in vehicle communications- Navigation- Connected Cars technology – Tracking-Security for data communication- dashboard display and Virtual Instrumentation, multimedia electronics- Role of IOT in Automotive systems

UNIT V	**ELECTRIC VEHICLES**	**9**

Electric vehicles –Components- Plug in Electrical vehicle- Charging station – Aggregators- Fuel cells/Solar powered vehicles- Autonomous vehicles.

TOTAL:	**45 PERIODS**

COURSE OUTCOMES:

CO1	Insight into the significance of the role of embedded system for automotive applications.
CO2	Illustrate the need, selection of sensors and actuators and interfacing with ECU
CO3	Develop the Embedded concepts for vehicle management and control systems.
CO4	Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs
CO5	Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.

REFERENCES:

1. William B. Ribbens," Understanding Automotive Electronics", Elseiver,2012
2. Jack Erjavec, Jeff Arias, "Alternate Fuel Technology-Electric, Hybrid& Fuel Cell Vehicles", Cengage ,2012.
3. Tom Denton, Automotive Electricals / Electronics System and Components, 3rd Edition, 2004.
4. Robert Bosch Gmbh, Automotive Electricals Electronics System and Components, 4th Edition,2004.
5. Ali Emedi, Mehrdedehsani, John M Miller, "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004.

6. L.Vlacic, M. Parent, F. Harahima," Intelligent Vehicle Technologies", SAE International,2001.
7. Chilton Automotive Books, Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford, W G Nichols Publishers, 1991
8. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1 edition, March 30, 2000.
9. Robert Bosch, Automotive Hand Book, Bently Publishers, 1997.
10. Jurgen, R., Automotive Electronics Hand Book

COs	POs						PSOs		
	1	2	3	4	5	6	1	2	3
1	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

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