ANNA UNIVERSITY: CHENNAI 600 025

UNIVERSITY DEPARTMENTS

M.E. AUTOMOBILE ENGINEERING

REGULATIONS - 2019

CHOICE BASED CREDIT SYSTEM

THE VISION OF THE DEPARTMENT OF AUTOMOBILE ENGINEERING IS :

"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"

THE MISSION OF THE DEPARTMENT OF AUTOMOBILE ENGINEERING IS :

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.

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UNIVERSITY DEPARTMENTS

M.E. AUTOMOBILE ENGINEERING (FT & PT)

REGULATIONS - 2019

CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Students will

i. Excel in their professional career in automobile industry.
ii. Exhibit research with highest professional and ethical standards.
iii. Acquire knowledge in basics of automobile engineering to apply in growth of the industry.
iv. Showcase professionalism, team work in their chosen profession and
v. Update themselves to recent trends, technologies and industrial scenarios by pursuing lifelong learning.

PROGRAMME OUTCOMES (POs)

After completion of their Under Graduate Program in Automobile Engineering, the graduates will demonstrate ability to:

POs	Graduate Attribute	Programme Outcome
1.	Engineering knowledge	Express strong basics skills in Mathematics, Science and Engineering.
2.	Problem analysis	Design and conduct Experiments, as well as to analyze and interpret data.
3.	Design/development of solutions	Design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and Safety, manufacturability and sustainability.
4.	Conduct investigations of complex problems	acquire the capability to identify, formulate and solve complex engineering problems related to Automobile Engineering
5.	Modern tool usage	Become familiar with modern engineering tools and analyze the problems within the domains of Automobile Engineering as the members of multidisciplinary teams.
6.	The engineer and society	Understand and work for the impact of development of Automobile engineering on global, economic environment and societal context.
7.	Environment and sustainability	Design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
8.	Ethics	Understand the professional and ethical responsibility with reference to their career in the field of Automobile Engineering
9.	Individual and team work	Work as team player or individual in solving their assigned task.
10.	Communication	Communicate effectively both in verbal non-verbal forms.
11.	Project management and finance	Understand engineering and management principles to apply for (his/her) own work and team. Manage projects in multidisciplinary environments with financial concise.
12.	Life-long learning	Pursue higher studies and do research in inter and multidisciplinary fields for continuous learning lifestyle.

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Mapping of PEOs with POs

Programme Educational Objectives	Programme Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
i.	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
ii.	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓
iii.	✓	✓	✓	✓	✓	✓	✓					✓
iv.			✓			✓		✓	✓	✓	✓	
v.	✓	✓	✓	✓	✓	✓	✓					✓

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		Subject	Programme Outcome											
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
YEAR 1	SEM I	Automotive Chassis	✓				✓	✓		✓	✓	✓	✓	✓
		Engine and Auxiliary System	✓	✓	✓			✓	✓	✓	✓	✓		✓
		Automotive Drive Line System	✓		✓		✓			✓	✓			✓
		Program Elective – I												
		Research Methodology and IPR												
		Audit Course – I												
		Engine and Chassis Components Laboratory	✓				✓	✓	✓	✓	✓	✓	✓	✓
		Design and Modelling of Vehicle Components Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
YEAR 1	SEM II	Vehicle body Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Automotive Engine Pollution and its Control			✓	✓	✓	✓	✓	✓				✓
		Dynamics of Road Vehicles	✓	✓	✓	✓	✓	✓		✓				✓
		Program Elective – II												
		Program Elective – III												
		Audit Course – II												
		Engine and Vehicle Testing Laboratory	✓	✓	✓	✓	✓	✓	✓		✓			✓
		Vehicle Electrical and Electronics Laboratory	✓	✓	✓	✓	✓			✓	✓			✓
		Mini Project with Seminar												

YEAR 2	SEM III	Engine Management Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Elective – IV												
		Elective – V												
		Open Elective												
		Dissertation - I												
	SEM IV	Dissertation - II												

ELECTIVES

Subject	Programme Outcome											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Alternative Fuels and Propulsion Systems	✓			✓	✓	✓	✓	✓				✓
Automotive Electrical and Electronics	✓	✓	✓	✓	✓			✓	✓			✓
Automotive Materials	✓	✓		✓		✓		✓	✓			✓
Automotive Safety	✓	✓	✓	✓	✓		✓	✓	✓			✓
Electric and Hybrid Vehicles	✓	✓	✓	✓	✓	✓		✓				✓
Engine Combustion Thermodynamics and Engine Heat Transfer	✓	✓		✓	✓	✓		✓				✓
Finite Element Methods in Automobile Engineering	✓	✓	✓	✓	✓			✓	✓			✓

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Hydraulic and Pneumatic Systems	✓	✓	✓	✓	✓	✓		✓	✓			✓
IC Engine Process Modelling	✓	✓	✓	✓	✓				✓			✓
Instrumentation and Experimental Technique	✓		✓		✓	✓	✓				✓	✓
Noise, Vibration and Harshness for Automobiles	✓	✓	✓	✓	✓	✓		✓				✓
Production of Automotive Components	✓	✓		✓	✓	✓	✓	✓			✓	✓
Road Vehicle Aerodynamics	✓	✓	✓	✓		✓	✓	✓	✓			✓
Special Purpose Vehicles		✓	✓		✓	✓	✓				✓	✓
Theory of Fuels and Lubricants	✓	✓			✓		✓	✓				✓
Two and Three Wheelers	✓	✓	✓			✓		✓				✓
Vehicle Air Conditioning Systems	✓	✓	✓	✓	✓	✓	✓	✓				✓
Vehicle Control Systems	✓	✓	✓	✓	✓	✓		✓				✓
Vehicle Maintenance	✓	✓	✓		✓	✓	✓	✓				✓
Vehicle Design	✓	✓	✓	✓	✓	✓	✓					✓
Advanced Numerical Methods												

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UNIVERSITY DEPARTMENTS

REGULATIONS - 2019

M.E. AUTOMOBILE ENGINEERING (FT and PT)

CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MA5154	Advanced Numerical Methods	FC	3	1	0	4	4
2.	AM5101	Automotive Chassis	PCC	3	1	0	4	4
3.	AM5102	Engine and Auxiliary System	PCC	3	0	0	3	3
4.	AM5103	Automotive Drive Line System	PCC	3	0	0	3	3
5.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Program Elective – I	PEC	3	0	0	3	3
7.		Audit Course – I*		2	0	0	2	0
PRACTICALS								
8.	AM5111	Engine and Chassis Components Laboratory	PCC	0	0	4	4	2
9.	AM5112	Design and Modelling of Vehicle Components Laboratory	PCC	0	0	4	4	2
			TOTAL	**19**	**2**	**8**	**29**	**23**

* Audit Course is optional.

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5201	Vehicle Body Engineering	PCC	3	0	0	3	3
2.	AM5202	Automotive Engine Pollution and its Control	PCC	3	0	0	3	3
3.	AM5203	Dynamics of Road Vehicle	PCC	3	0	0	3	3
4.		Program Elective – II	PEC	3	0	0	3	3
5.		Program Elective – III	PEC	3	0	0	3	3
6.		Audit Course – II*		2	0	0	2	0
PRACTICALS								
7.	AM5211	Engine and Vehicle Testing Laboratory	PCC	0	0	4	4	2
8.	AM5212	Vehicle Electrical and Electronics Laboratory	PCC	0	0	4	4	2
9.	AM5213	Mini Project with Seminar	EEC	0	0	4	4	2
			TOTAL	**17**	**0**	**12**	**29**	**21**

* Audit Course is optional.

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SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5301	Engine Management Systems	PCC	3	0	0	3	3
2.		Program Elective – IV	PEC	3	0	0	3	3
3.		Program Elective – V	PEC	3	0	0	3	3
4.		Open Elective	PEC	3	0	0	3	3
PRACTICALS								
5.	AM5311	Dissertation 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		
PRACTICALS								
1.	AM5411	Dissertation II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE - 74

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UNIVERSITY DEPARTMENTS

REGULATIONS - 2019

M.E. AUTOMOBILE ENGINEERING (PART - TIME)

I TO VI SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5101	Automotive Chassis	PCC	3	1	0	4	4
2.	AM5102	Engine and Auxiliary System	PCC	3	0	0	3	3
3.	MA5154	Advanced Numerical Methods	FC	3	1	0	4	4
4.		Program Elective – I	PEC	3	0	0	3	3
5.		Audit Course – I*		2	0	0	2	0
PRACTICALS								
6.	AM5111	Engine and Chassis Components Laboratory	PCC	0	0	4	4	2
			TOTAL	**14**	**2**	**4**	**20**	**16**

* Audit Course is optional.

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5103	Automotive Drive line System	PCC	3	0	0	3	3
2.	AM5201	Vehicle Body Engineering	PCC	3	0	0	3	3
3.		Program Elective – II	PEC	3	0	0	3	3
4.		Audit Course – II*		2	0	0	2	0
PRACTICALS								
5.	AM5212	Vehicle Electrical and Electronics Laboratory	PCC	0	0	4	4	2
			TOTAL	**11**	**0**	**4**	**15**	**11**

* Audit Course is optional.

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SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5202	Automotive Engine Pollution and its Control	PCC	3	0	0	3	3
2.		Program Elective – III	PEC	3	0	0	3	3
3.		Program Elective – IV	PEC	3	0	0	3	3
PRACTICALS								
4.	AM5211	Engine and Vehicle Testing Laboratory	PCC	0	0	4	4	2
			TOTAL	**9**	**1**	**4**	**13**	**11**

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5203	Dynamics of Road Vehicle	PCC	3	0	0	3	3
2.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
3.		Program Elective – V	PEC	3	0	0	3	3
PRACTICALS								
4.	AM5112	Design and Modelling of Vehicle Components Laboratory	PCC	0	0	4	4	2
5.	AM5213	Mini Project with Seminar	EEC	0	0	4	4	2
			TOTAL	**8**	**0**	**8**	**16**	**12**

SEMESTER V

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5301	Engine Management Systems	PCC	3	0	0	3	3
2.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
3.	AM5311	Dissertation – I	EEC	0	0	12	12	6
			TOTAL	**6**	**0**	**12**	**18**	**12**

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SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	AM5411	Dissertation – II	EEC	0	0	24	24	12
			TOTAL	0	0	24	24	12

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE : 74

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FOUNDATION COURSE (FC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MA5154	Advanced Numerical Methods	FC	3	1	0	4	4

PROFESSIONAL CORE COURSES (PCC)

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	AM5101	Automotive Chassis	PCC	3	1	0	4	4
2	AM5102	Engine and Auxiliary system	PCC	3	0	0	3	3
3	AM5103	Automotive Drive line System	PCC	3	0	0	3	3
4	AM5201	Vehicle body Engineering	PCC	3	0	0	3	3
5	AM5202	Automotive Engine Pollution and its Control	PCC	3	0	0	3	3
6	AM5203	Dynamics of Road Vehicle	PCC	3	0	0	3	3
7	AM5301	Engine Management Systems	PCC	3	0	0	3	3
8	AM5111	Engine and Chassis Components Laboratory	PCC	0	0	4	4	2
9	AM5112	Design and Modelling of Vehicle Components Laboratory	PCC	0	0	4	4	2
10	AM5211	Engine and Vehicle Testing Laboratory	PCC	0	0	4	4	2
11	AM5212	Vehicle Electrical and Electronics Laboratory	PCC	0	0	4	4	2

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PROGRAM ELECTIVES COURSES

SEMESTER I, ELECTIVE – I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5001	Vehicle Design	PEC	3	0	0	3	3
2.	AM5002	Automotive Materials	PEC	3	0	0	3	3
3.	AM5003	Special Purpose Vehicles	PEC	3	0	0	3	3
4.	AM5004	Instrumentation and Experimental Techniques	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE – II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5071	Automotive Electrical and Electronics	PEC	3	0	0	3	3
2.	AM5005	Finite Element Methods in Automobile Engineering	PEC	3	0	0	3	3
3.	AM5006	Noise, Vibration and Harshness for Automobiles	PEC	3	0	0	3	3
4.	AM5007	Two and Three Wheelers	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5008	Alternative Fuels and Propulsion Systems	PEC	3	0	0	3	3
2.	AM5009	Hydraulic and Pneumatic Systems	PEC	3	0	0	3	3
3.	AM5010	IC Engine Process Modelling	PEC	3	0	0	3	3
4.	AM5011	Vehicle Control Systems	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5012	Road Vehicle Aerodynamics	PEC	3	0	0	3	3
2.	AM5013	Electric and Hybrid Vehicles	PEC	3	0	0	3	3
3.	AM5014	Vehicle Maintenance	PEC	3	0	0	3	3
4.	AM5015	Production of Automotive Components	PEC	3	0	0	3	3

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SEMESTER III, ELECTIVE – V

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AM5016	Vehicle Air Conditioning Systems	PEC	3	0	0	3	3
2.	AM5017	Automotive Safety	PEC	3	0	0	3	3
3.	AM5018	Engine Combustion Thermodynamics and Engine Heat Transfer	PEC	3	0	0	3	3
4.	AM5019	Theory of Fuels and Lubricants	PEC	3	0	0	3	3

OPEN ELECTIVE COURSES [OEC]

(Out of 6 Courses one Course must be selected)

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OE5091	Business Data Analytics	OEC	3	0	0	3	3
2.	OE5092	Industrial Safety	OEC	3	0	0	3	3
3.	OE5093	Operations Research	OEC	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	OEC	3	0	0	3	3
5.	OE5095	Composite Materials	OEC	3	0	0	3	3
6.	OE5096	Waste to Energy	OEC	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	AX5091	English for Research Paper Writing	2	0	0	0
2.	AX5092	Disaster Management	2	0	0	0
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0
4.	AX5094	Value Education	2	0	0	0
5.	AX5095	Constitution of India	2	0	0	0
6.	AX5096	Pedagogy Studies	2	0	0	0
7.	AX5097	Stress Management by Yoga	2	0	0	0
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0

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RESEARCH METHODOLOGY AND IPR COURSES (RMC)

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	RM5151	Research Methodology and IPR	2	0	0	2	1

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	AM5213	Mini Project with Seminar	0	0	4	2	2
2	AM5311	Dissertation – I	0	0	12	6	3
3	AM5411	Dissertation – II	0	0	24	12	4

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MA5154 **ADVANCED NUMERICAL METHODS** **L T P C**
3 1 0 4

OBJECTIVES:

- To impart knowledge in understanding the advantages of various solution procedures of solving the system of linear and nonlinear equations.
- To give a clear picture about the solution methods for solving the BVPs and the system of IVPs.
- To acquire knowledge in solving time dependent one and two dimensional parabolic PDEs by using various methodologies.
- To strengthen the knowledge of finite difference methods for solving elliptic equations.
- To get exposed to the ideas of solving PDEs by finite element method.

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

- Get familiarized with the methods which are required for solving system of linear, nonlinear equations and eigenvalue problems.
- Solve the BVPs and the system of IVPs by appropriate methods discussed.
- Solve time dependent parabolic PDEs by using various methodologies up to dimension two.
- Solve elliptic equations by finite difference methods.
- Use the ideas of solving PDEs by finite element method.

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REFERENCES:
1. Burden, R.L., and Faires, J.D., “Numerical Analysis – Theory and Applications”, Cengage Learning, India Edition, New Delhi, 2010.
2. Gupta S.K., “Numerical Methods for Engineers”, New Age Publishers, 3rd Edition, New Delhi, 2015.
3. Jain M. K., Iyengar S. R. K., Jain R.K., “Computational Methods for Partial Differential Equations”, New Age Publishers, 2nd Edition, New Delhi, 2016.
4. Morton K.W. and Mayers D.F., “Numerical solution of partial differential equations”, Cambridge University press, Cambridge, 2005.
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.

AM5101 AUTOMOTIVE CHASSIS L T P C
3 1 0 4

OBJECTIVES:
- 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.
- To recognize the construction and working principle of drive line, final drive and differential systems
- To review the knowledge about the constructional feature of rear axle, wheels and tyres.
- To evaluate the working principles of both conventional and independent suspension system.
- To demonstrate working principle of braking system used in automobile.

UNIT I LAYOUT, FRAME, FRONT AXLE AND STEERING SYSTEM 12

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

UNIT II DRIVE LINE, FINAL DRIVE AND DIFFERENTIAL 12

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

UNIT III REAR AXLES, WHEELS, RIMS AND TYRES 12

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

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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, Shock Absorbers, Types and Constructional details, Design of Leaf and Coil Springs.

UNIT V BRAKING SYSTEM 12

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

TOTAL= 60 PERIODS

OUTCOMES:

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

- Identify the different types of frame and chassis used in Automotive.
- Relate different types of drive lines and drives used in Automotive.
- Acquire knowledge about different types of front axle and rear axles used in motor vehicles.
- Examine the working principle of conventional and independent suspension systems.
- Apply knowledge on working principles of brake and its subsystems.

REFERENCES

1. Heldt P.M., “Automotive Chassis” Chilton Co., New York, 1952
2. Kripal Singh, “Automobile Engineering (Volume - 1)”, 12th Edition, Standard Publishers Distributors, 2011.
3. R.K. Rajput, “A Text Book of Automobile Engineering”, Laxmi Publications Private Limited, 2007
4. N.K. Giri, “Automotive Mechanics” Khanna Publishers, New Delhi, 2005
5. Kenneth Garrett, Kenneth Newton and William Steeds, “The Motor Vehicle” 13th Edition, Butterworth-Heinemann Limited, London, 2005.
6. Heinz Heisler, “Vehicle and Engine Technology”, Second Edition, SAE, USA, 1999.

AM5102 ENGINE AND AUXILLARY SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on engine operation and its constructional details
- Understand various subsystems involved in engine operation
- To impart knowledge to design and analyse engine operating parameters like air fuel ratio, injection parameters etc
- Understand the concept of combustion and its effects under various conditions
- To impart knowledge on recent developments on IC engines.

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.

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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.

UNIT III AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS 9

Combustion stoichiometry- Combustion reactions- chemical equilibrium Combustion in SI and CI engines - 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

Air cooling and water cooling – thermo syphon cooling, forced cooling systems. Fins and radiator - design calculation. Theory of lubrication — types of lubrication, splash lubrication system, petroil lubrication system, forced feed lubrication system. Properties of engine lubricants. Supercharger and Turbochargers. Modification of an engine for supercharging. Effect of supercharging on engine performance. Variable geometry and variable nozzle turbocharger. E-Turbocharger. Problems.

UNIT V NEW ENGINE TECHNOLOGY 9

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

TOTAL : 45 PERIODS

OUTCOMES:

- Students will have the basic knowledge on Automotive Engines and its various sub systems along with its functions.
- Student can able to design and solve engine related problems
- Student will have command knowledge over recent development in the area of internal combustion engines.
- Student can apply their knowledge to analyse and correlate the data with recent requirements of automobile industry
- Student to can explore new alternate fuels or energy system to run the automobile

REFERENCES:

1. J.B.Heywood, 'Internal combustion engine Fundamentals', McGraw Hill Book Co, 1989.
2. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2012.
3. Edward F.Obert, 'Internal combustion engines and air pollution' Harber and Row Publishers, 1973.
4. M.Khovakh, 'Motor Vehicle Engines', Mir Publishers, Mascow,1976
5. Heinz Helzler " Advenced Engine Technology" E. Arnold, 1995
6. W.H.Crouse and A.L.Anglin, 'Automotive Emission control', McGraw Hill Book Co, 1995.
7. G.S.Springer and A.J.Patterson, 'Engine emissions and pollutant formation', plenum press, New york, 1985.

AM5103 **AUTOMOTIVE DRIVE LINE SYSTEM** **L T P C**
3 0 0 3

OBJECTIVES:

- To impart knowledge on detailed concept, construction and principle of operation of various types of mechanical transmission components
- To design various transmission components like clutch and gear box
- To expose recent developments of automobile transmission
- To design and select Hydrodynamic Transmission for various applications
- To understand Electric drive used in road vehicles automatic transmission system.

UNIT I CLUTCH **9**

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

UNIT II GEAR BOX **9**

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

UNIT III HYDRODYNAMIC TRANSMISSION **9**

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

UNIT IV 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.

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire knowledge in detailed concept, construction and principle of clutches.
- Understand the concept, construction and principle of gear box
- Examine the usage of Hydrodynamic devices, hydrostatic devices, automatic transmission system
- Apply a knowledge on hydrostatic devices
- Understand Electric drive used in road vehicles automatic transmission system.

REFERENCES:

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.
3. Crouse,W.H., Anglin,D.L., Automotive Transmission and Power Trains construction, McGraw Hill, 1976.
4. Heldt,P.M., Torque converters, Chilton Book Co., 1962.

RM5151 **RESEARCH METHODOLOGY AND IPR** **L T P C**
2 0 0 2

COURSE OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION **6**

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW **6**

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION **6**

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) **6**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) **6**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc.
Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

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AM5111 ENGINE AND CHASSIS COMPONENTS LABORATORY **L T P C**
0 0 4 2

OBJECTIVES:

- To assemble and disassemble the parts of an IC engine.
- To identify the various component of an IC engine.
- To identify the various components in transmission systems of an automobile.
- To assemble and disassemble the various components of transmission system.

LIST OF EXPERIMENTS

1. To assemble and disassemble 1000CC engine
2. To assemble and disassemble six cylinder engine
3. To assemble and disassemble V8 engine
4. To assemble and disassemble CRDI engine
5. To assemble and disassemble MPFI engine
6. To assemble and disassemble Single plate, Diaphragm Clutch.
7. To assemble and disassemble Constant mesh, Sliding mesh gear box
8. To assemble and disassemble Transfer case
9. To assemble and disassemble Differential, Rear axle
10. To assemble and disassemble Front axle.
11. To Study different chassis layouts
12. To Study braking system
13. To Study Steering system
14. To Study Suspension system

TOTAL: 60 PERIODS

OUTCOMES:

- Dismantle and Assemble the automobile chassis and Engine components
- Identify & differentiate components of SI & CI engines
- Understand working of braking, steering, clutch, transmission, Suspension systems.
- Differentiate various subsystems of two, three & Four wheeler vehicles
- Develop skills in Dismantling and assembling of chassis components.
- Correct minor repairs and trouble shoots the breakdowns.

AM5112 DESIGN AND MODELLING OF VEHICLE COMPONENTS LABORATORY **L T P C**
0 0 4 2

OBJECTIVES:

- To familiarize the students to use modeling software for modelling engine components
- To design chassis components with dimensions and strength requirements.
- To learn the use of standard practices in modeling of components.
- The use of modeling software to control the quality of the final engineered product.
- To visualize the complete assembly of the various system.

LIST OF ENGINE DESIGN EXPERIMENTS

1. Design and modelling of piston, piston pin and piston rings.
2. Design modelling of the connecting rod assembly.
3. Design of crankshaft, balancing weight calculations and modelling of the crankshaft assembly.
4. Design and modelling of flywheel
5. Design and modelling of the inlet and exhaust valves.
6. Design and modelling of cam and camshaft.
7. Design and modelling of combustion chamber.

LIST OF CHASSIS DESIGN EXPERIMENTS

8. Design and modelling of frame
9. Design and modelling of clutch assembly.
10. Design and modelling of constant mesh gearbox
11. Design and modelling of sliding mesh gearbox
12. Design and modelling of propeller shaft with universal joint.
13. Design and modelling of rear axle

TOTAL: 60 PERIODS

OUTCOMES:

Students will be able to

- visualize the automotive components with the help of modelling software.
- make the modifications instantly if required at the initial stage itself
- synthesize, analyse and document the design of the various components

AM5201 VEHICLE BODY ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To acquire knowledge on Different aspects of car body,
- To acquire knowledge on bus body and commercial vehicle bodies.
- To acquire knowledge on Role of various aerodynamic forces and moments, measuring instruments in vehicle body design.
- To acquire knowledge on Material used in body building,
- To acquire knowledge on Tools used in body repairs and command over vehicle body engineering applications.

UNIT I CAR BODY DETAILS 10

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. Safety: Safety design, safety equipment for cars. AIS and SAE car body Regulations

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 – Constructional details: Conventional and integral. AIS and SAE bus body Regulations

UNIT III COMMERCIAL VEHICLE DETAILS 8

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 – Drivers 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 BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR 9

Types and properties of materials used in body construction and insulation -Such as steel sheet, timber, plastics and GRP, Insulation materials. Body trim items-body mechanisms. Hand tools-power tools for body repair. Vehicle corrosion-Anticorrosion methods-Modern painting process procedure.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, students will acquire knowledge on

- Different aspects of car body,
- bus body and commercial vehicle bodies.
- Role of various aerodynamic forces and moments, measuring instruments in vehicle body design.
- Material used in body building,
- Tools used in body repairs and command over vehicle body engineering applications.

REFERENCES:

1. Powloski, J., Vehicle Body Engineering, Business Books Ltd., 1998.
2. James E Duffy, Body Repair Technology for 4-Wheelers,Cengage Learning,2009.
3. Thomas Christian Schuetz, Aerodynamics of Road Vehicles, Fifth Edition, SAE International, 2016
4. Braithwaite, J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London,1997.
5. Dieler Anselm., The passenger car body, SAE International, 2000
6. Giles, G.J., Body construction and design, Illiffe Books Butterworth & Co., 1991.

AM5202 AUTOMOTIVE ENGINE POLLUTION AND ITS CONTROL L T P C

3 0 0 3

OBJECTIVES:

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

UNIT I EMISSION FROM AUTOMOBILES 5

Sources of Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment human beings. Emission control techniques – Emission standards.

UNIT II EMISSION FROM SPARK IGNITION ENGINE AND ITS CONTROL 12

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

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UNIT III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL **12**

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, Particulate Traps, SCR — Cetane number Effect.

UNIT IV NOISE POLLUTION FROM AUTOMOBILES **8**

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

UNIT V TEST PROCEDURES AND EMISSION MEASUREMENTS **8**

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

TOTAL : 45 PERIODS

OUTCOMES:

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

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

REFERENCES

1. G.P.Springer and D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.
2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.
3. Engine Emissions, B.P Pundir , Narosa publications 2nd edition 2017
4. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
5. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company., New york 1993.
6. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., New york 1993.
7. C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.
8. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise', Applied science publisher ltd., London,1987

		L	T	P	C
AM5203	**DYNAMICS OF ROAD VEHICLE**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To provide fundamental knowledge of the dynamics of ground vehicles,
- To impart knowledge of suspension design and function,
- To provide basic concepts on concerning stability and control
- To understand basic analysis of vehicle dynamics in performance, handling and ride modes.
- To Evaluate the longitudinal dynamics and control in a automobile

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UNIT I CONCEPT OF VIBRATION 9

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

UNIT II TYRES 9

Tyre axis system, tyre forces and moments, tyre marking, tyre structure, hydroplaning, wheel and rim. Rolling resistance, factors affecting rolling resistance, Longitudinal and Lateral force at various slip angles, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tyres. Various test carried on a tyre.

UNIT III VERTICAL DYNAMICS 9

Human response to vibration, Sources of Vibration. Suspension requirements – types. State Space Representation. 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 9

Aerodynamic forces and moments. 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. 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 9

Steady state handling characteristics. Steady state response to steering input – Yaw velocity gain, Lateral acceleration gain, curvature response gain. Testing of handling characteristics. Transient response characteristics. Steering dynamics. Direction control of vehicles. Roll center, Roll axis. Stability of vehicle on banked road, during turn. Effect of suspension on cornering. Minuro Plot for Lateral Transient Response.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop physical and mathematical models to predict the dynamic response of vehicles
- Apply vehicle design performance criteria and how to use the criteria to evaluate vehicle dynamic response
- Use dynamic analyses in the design of vehicles.
- Understand the principle behind the lateral dynamics.
- Evaluate the longitudinal dynamics and control in a automobile

REFERENCES:

1. Singiresu S. Rao, "Mechanical Vibrations," Fifth Edition, Prentice Hall, 2010
2. J. Y. Wong, "Theory of Ground Vehicles", Fourth Edition, Wiley-Interscience, 2008
3. Rajesh Rajamani, "Vehicle Dynamics and Control," Second edition, Springer, 2012
4. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics," Society of Automotive Engineers Inc, 2014
5. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", Second Edition, CRC Press, 2013
6. R. Nakhaie Jazar, "Vehicle Dynamics: Theory and Application", Second edition, Springer, 2013
7. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics", Elsevier Limited, 2004
8. Hans B Pacejka, "Tyre and Vehicle Dynamics," Second edition, SAE International, 2005

AM5211 ENGINE AND VEHICLE TESTING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To impart knowledge in automotive Emission measurement and methods of testing engines.
- To categorize the different measuring techniques of pollutants like UBHC, CO, NOx, CO2 and smoke.
- To Investigate the performance and combustion parameters for different engine models
- To learn removal and fitting of automotive accessories
- To understand the adjustment of play in various automobile components.

LIST OF EXPERIMENTS ON ENGINE TESTING:

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

LIST OF EXPERIMENTS ON 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. Fault diagnosis and service of Electrical system like battery, starting system, charging system, lighting system.
7. Work on body and paint shop.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Analysis of combustion parameters
- Differentiate the variation performance parameters of diesel engines
- Differentiate the variation performance parameters of diesel engines
- Learn removal and fitting of automotive accessories
- Understand the adjustment of play in various automobile components.

AM5212 VEHICLE ELECTRICAL AND ELECTRONICS LABORATORY L T P C
0 0 4 2

OBJECTIVE:

To import the knowledge in the area of automotive electrical system and electronic system associated in modern vehicles.

LIST OF EXPERIMENTS:

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

2. Study of a. automotive lighting system and adjustment of head lights beam
a. major electrical components used in modern vehicles
b. diagnostic tool used in vehicle

3. Dismantling, testing and assembling of Starter system components

4. Dismantling, testing and assembling of charging system components

5. Basic Analog Experiments like
a. Logic gates, Adders, Flip flops
b. Amplifier, filter,
c. Multiplexer and De-multiplexer

6. Interfacing seven segment displays

7. Microprocessor and microcontroller programming
a. Arithmetic and Logic operation,
b. Code conversion,
c. Waveform generation,
d. Look up table

8. Interfacing ADC and DAC for Data Acquisition and Control Application

9. Interfacing Sensors for Measurements of position, displacement, velocity, force, temperature, proximity/range

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

*Mini Project

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course the students will be able to have the knowledge in

- Automotive electrical systems and electrical accessories
- Basic microprocessor / microcontroller programming
- Automotive sensor, transducer, actuator, virtual instrumentation, data acquisition
- Development of embedded systems for automobiles

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

OBJECTIVES:

- To impart knowledge on engine management systems viz fuel injection, ignition system.
- To understand various controlling system for emission control and engine operation
- To provide opportunities to discuss the fundamentals of engine control sensors and actuators,
- To identify and analyze electric and electronic related problems
- To distinguish various engine control algorithm used during engine operation.

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UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9

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

UNIT II SENSORS AND ACTUATORS 9

Inductive, Hall Effect, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine speed sensor, exhaust oxygen level(two step, linear lambda and wideband), knock, manifold temperature and pressure sensors. Solenoid, relay(four and five pin), stepper motor

UNIT III SI ENGINE MANAGEMENT 9

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

UNIT IV CI ENGINE MANAGEMENT 9

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Electronically controlled Unit Injection system. Common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve.

UNIT V DIGITAL ENGINE CONTROL SYSTEM 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

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

REFERENCES:

1. Understanding Automotive Electronics William B Ribbens, SAE 1998
2. Automobile Electronics by Eric Chowanietz SAE
3. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
4. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004

AM5001 **VEHICLE DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I DESIGN OF CYLINDER, PISTON AND CONNECTING ROD 10

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 design of piston for passenger car.

UNIT II DESIGN OF CRANK SHAFT AND VALVES 9

Material for crankshaft, design of crankshaft under bending and twisting. Design aspects of intake & exhaust manifolds, inlet & exhaust valves, valve springs, tappets and valve train. Design of cam & camshaft. Design of rocker arm. Cam profile generation. Case Study on design of camshaft for a four stroke IC engine.

UNIT III DESIGN OF CLUTCHES AND GEARS 10

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. Case study on design of gearbox assembly for an ATV.

UNIT IV DESIGN OF VEHICLE FRAME AND SUSPENSION 6

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. Case study on development of frame for ATV.

UNIT V DESIGN OF FRONT AND REAR AXLE 10

Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings. Case study Analysis of loads-moments and stresses at different sections of front axle. Determination of optimum dimensions and proportions for steering linkages, Design of front axle beam.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Analyse the stress and strain imparted on automotive components
- Compute the design and find the dimension of the vehicle components.
- Identify optimal design solutions to real-world problems in compliance with industry standards.
- Demonstrate the design skill by creating new design strategy with the application of the knowledge.
- Interpret the modern system in vehicle and would help in developing the system with less impact to the environment.

REFERENCES:

1. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.
2. Kolchin-Demidov , “Design of Automotive Engines”-Mir Publishers (1984)
3. Stokes , “Manual gearbox design”, Butterworth-Heinemann 1992

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4. “Design Data Hand Book”, PSG College of Technology, 2013- Coimbatore.
5. Dean Averns, "Automobile Chassis Design", Illife Book Co., 2001.
6. Giancarlo Genta, Lorenzo Morello, “The Automotive Chassis Volume 1, Components Design”, Springer International Edition.2014
7. Lukin P G G and Rodionov V, “Automobile Chassis Design and Calculations”, Mir Publishers, Moscow, 1989.
8. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,6th Edition, Wiley, 2017

AM5002 AUTOMOTIVE MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVES

The course should enable the students to:

- select suitable materials for design
- understand the concepts of heat treatment and surface modification techniques
- gain knowledge on materials and their applications in automotive applications
- analyze the properties of different materials used for automotive structures, engine and transmission systems.
- gain knowledge on advanced metallic and non- metallic materials.

UNIT I INTRODUCTION **9**

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

UNIT II METALLIC MATERIALS **9**

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

UNIT III COMPOSITES **9**

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

UNIT IV ELECTRICAL AND MAGNETIC MATERIALS **9**

Semiconductors materials, single crystals, soft and hard magnets, superconductors, MEMS materials, nano-materials, smart-materials, shape memory alloys. Piezoelectric materials. Piezoceramic materials, polyvinyldenefluoride, Magnetostrictive Materials. Metglasmaterials.

UNIT V RUBBER AND PLASTICS MATERIALS **9**

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

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TOTAL: 45 PERIODS

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OUTCOMES

The student will be able to:

- Understand failure mechanisms.
- Gain knowledge on different class of materials and their applications
- Understand the Selection criteria for various components and importance.
- Select proper material for Automobile applications
- Understand different materials used for sensors in a vehicle

REFERENCES

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, 2006.
3. Geoffrey Davies, "Materials for Automobile Bodies", Butterworth-Heinemann, 2012
4. Hiroshi Yamagata," The Science and Technology of Materials in Automotive Engines", Woodhead Publishing, 2005
5. Smallman R. E, Bishop R. J," Modern Physical Metallurgy and Materials Engineering- Science, process, applications", Sixth Edition, Butterworth-Heinemann, 1999

AM5003 SPECIAL PURPOSE VEHICLES L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I EARTH MOVING EQUIPMENTS 9

Construction layout, capacity, specification 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 for prime mover.

UNIT II CONSTRUCTIONAL EQUIPMENTS 10

Construction layout, capacity, specification and applications of cranes – types , Articulated Trucks ,concrete ready mixer ,trenchers , Asphalt Pavers , road reclaimers , General description, specification and functions of smooth wheeled rollers, pneumatic tired rollers, , sheep's foot rollers, vibrating compactors , draglines, drillers ,borewell 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 of paddy harvesting machines, Sugarcane harvesting, feller bunchers, forest machines.

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UNIT IV INDUSTRIAL VEHICLE 9

General description, specification, capacity and working of fork lifts - attachment, Utility vehicles, towing vehicles, man-lift chassis, scissor lift trucks, material handlers, fire fighting vehicle, reclaimers, Street sweepers

UNIT V MILITARY AND COMBAT VEHICLES 8

Special features and constructional details of Main Battle tank, gun carriers, truck-mounted missile launchers, transport vehicles, armoured vehicle-launched bridge, amphibious bridging vehicle, and communication vehicles.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

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

REFERENCES:

1. Abrosimov. K. Bran berg.A. andKatayer.K., " Road making Machinery ", MIR Publishers, Moscow, 1971.
2. Jerry Scutts, "Advanced Military Vehicle Modelling" , Osprey Publishing, 1999
3. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers, 1987.
4. B. Geleman and M. Moskovin, Farm tractors, MIR publishers, Moscow.
5. Kolchin,A., and V.Demidov, Design of Automotive Engines for Tractor, MIR Publishers, 1972.
6. Off the road wheeled and combined traction devices - Ashgate Publishing Co. Ltd. 1998.
7. Peurifoy R.L "Construction Planning, Equipment and Methods", Tata McGraw-Hill, New Delhi, 2002.
8. Wong J " Terramechanics and Off-Road Vehicle Engineering", Butterworth-Heinemann, 2009

AM5004 INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I MEASUREMENT SYSTEMS 8

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

UNIT II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES 8

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

UNIT III MECHANICAL MEASUREMENT 10

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

UNIT IV ENGINE EXPERIMENTAL TECHNIQUES 10

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

UNIT V VEHICLE EXPERIMENTAL TECHNIQUES 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

REFERENCES

1. J.G. Giles, 'Engine and Vehicle Testing', Illiffe books Ltd., London,1968.
2. W. Judge, 'Engineering Precision Measurement', Chapman and Hall Ltd, Essex StreetW.C.,1951,
3. Rangan, Sharma and Mani, 'Instrumentation Devices and systems', Tata McGraw Hill Publishing Co., Ltd., 1990
4. T.G. Beckwith and Buck, 'Mechanical Measurements', Oxford and IBH Publishing House, NewDelhi, 1995
5. D.Patambis, 'Principle of Industrial Instrumentation', Tata McGraw Hill Publishing Co, New Delhi,1990.

AM5071	AUTOMOTIVE ELECTRICAL AND ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems
- To understand the need for starter batteries, starter motor and alternator in the vehicle.
- To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
- To list common types of sensor and actuators used in vehicles.
- To understand dash – Board Instruments, various sensors and networking in vehicles.

UNIT I BATTERY AND STARTING SYSTEMS 9

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

UNIT II CHARGING AND LIGHTING SYSTEMS 9

D.C. Generators and Alternators their Characteristics. Control cutout, Electrical, Electromechanical and electronic regulators. Regulations for charging. Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system,head light dazzling and preventive methods. Lighting design.

UNIT III ELECTRONIC IGNITION AND INJECTION SYSTEMS 9

Types of electronic ignition systems - variable ignition timing, distributor less ignition. Spark timing control. TBI, MPFI, GDI Systems. Engine mapping.

UNIT IV ELECTRICAL SYSTEMS 9

Warning and alarm instruments : Brake actuation warning system, traficators, flash system, oil pressure warning system, engine over heat warning system, air pressure warning system, speed warning system, door lock indicators, neutral gear indicator, horn design, permanent magnet horn, air & music horns. Wind shield wiper. window washer, instrument wiring system and electromagnetic interference suppression, wiring circuits for instruments, electronic instruments, dash board illumination.

UNIT V MICROPROCESSOR IN AUTOMOBILES 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

- Define the glossary related to vehicle electrical and electronic system
- Understand the need for starter batteries, starter motor and alternator in the vehicle.
- Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
- List common types of sensor and actuators used in vehicles.
- Understand networking in vehicles.

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REFERENCES:

1. Judge. A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 1992.
2. William B. Ribbens -Understanding Automotive Electronics, 5th edition- Butter worth Heinemann, 1998
3. Young. A.P., & Griffiths. L., Automobile Electrical Equipment, English Language Book Society & New Press, 1990.
4. Vinal. G.W., Storage Batteries, John Wiley & Sons inc., New York, 1985.
5. Crouse.W.H., Automobile Electrical Equipment, McGraw Hill Book Co Inc., New York, 1980.
6. Spreadbury.F.G., Electrical Ignition Equipment, Constable & Co Ltd., London, 1962.
7. Robert N Brady Automotive Computers and Digital Instrumentation, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.

AM5005 FINITE ELEMENT METHODS IN AUTOMOBILE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To equip the students with the Finite Element Analysis fundamentals.
- To enable the students to formulate the design problems into FEA.
- To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions
- To understand the assembly of global arrays, and solution of the resulting algebraic systems.
- 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.

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UNIT V HEAT TRANSFER ANALYSIS AND FLOW ANALYSIS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

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

REFERENCES

1. 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,
5. 1987.
6. Bathe,K.J. and Wilson,E.L., Numerical methods in finite element analysis, Prentice Hall of India Ltd., 1983.
7. J. N. Reddy, “Finite Element Methods”, 2nd Edition, 6th Reprint, Tata McGraw Hill, 2005.
8. Singiresu S. Rao, “The Finite Elements Methods in Engineering”, 4th Edition, USA, 2005.

AM5006 NOISE, VIBRATION AND HARSHNESS FOR AUTOMOBILES L T P C

3 0 0 3

OBJECTIVES:

The course should enable the students to:

1. To introduce source of noise and vibration
2. To broaden the understanding of sound measurement and human sensitivity
3. To underline the importance of simulation, anechoic chamber and acoustic holography
4. To broaden the importance of statistical and frequency analysis
5. To introduce active control techniques

UNIT I NVH IN THE AUTOMOTIVE INDUSTRY 9

Sources of noise and vibration. Design features. Common problems. Marque values. Noise quality. Pass-by noise requirements. Target vehicles and objective targets. Development stages in a new vehicle programme and the altering role of NVH engineers.

UNIT II SOUND AND VIBRATION THEORY 9

Sound measurement. Human sensitivity and weighting factors. Combining sound sources. Acoustical resonances. Properties of acoustic materials. Transient and steady state response of one degree of freedom system applied to vehicle systems. Transmissibility. Modes of vibration.

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UNIT III TEST FACILITIES AND INSTRUMENTATION 9

Laboratory simulation: rolling roads (dynamometers), road simulators, semi-anechoic rooms, wind tunnels, etc. Transducers, signal conditioning and recording systems. Binaural head recordings. Sound Intensity technique, Acoustic Holography, Statistical Energy Analysis

UNIT IV SIGNAL PROCESSING 9

Sampling, aliasing and resolution. Statistical analysis. Frequency analysis. Campbell's plots, cascade diagrams, coherence and correlation functions.

UNIT V NVH CONTROL STRATEGIES & COMFORT 9

Source ranking. Noise path analysis. Modal analysis. Design of Experiments, Optimisation of dynamic characteristics. Vibration absorbers and Helmholtz resonators. Active control techniques.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course the student will be able to:

1. Identify sources of noise and vibration
2. Measure sound intensity and human sensitivity
3. Carryout statistical energy analysis and simulators
4. Determine active control techniques
5. Carryout statistical and frequency analysis barrier.

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. Colin H Hansen “Understanding Active Noise Cancellation “ , Spon Press , London .2003
4. David A.Bies and Colin H.Hansen “Engineering Noise Control: Theory and Practice “ Spon Press , London . *2009*
5. Matthew Harrison “Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles “,Elsevier Butterworth-2004

AM5007 TWO AND THREE WHEELERS L T P C

3 0 0 3

OBJECTIVES:

The objective of this course is to make the students to

- analyse various two wheelers and their dynamics
- design the power unit
- apply the design aspects of transmission system
- analyse different frames and suspension system used in two wheelers.
- design and analyse Three wheelers

UNIT I INTRODUCTION 9

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

UNIT II POWER UNITS, IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS 10

Two stroke and four stroke engines. Single, twin and multi cylinder engines. Air cooled and liquid cooled engines. Carburetted, PFI, MPFI and GDI engines. Design criteria for engines. Battery coil ignition, magneto ignition and electronic ignition. Lighting and other electrical systems.

UNIT III CLUTCHES AND TRANSMISSION 10

Pre-unit, gearbox and final drive. Design of clutch. Types of clutches and gear boxes. Gear change mechanism. CVT. Belt, chain and shaft drive. Freewheeling devices, starting systems.

UNIT IV FRAMES, SUSPENSION, WHEELS, TYRES AND BRAKES 8

Types of frames. Design of frames for fatigue strength, torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details of wheel and tyres. Braking systems.

UNIT V THREE WHEELERS 8

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

TOTAL : 45 PERIODS

OUTCOMES

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

- Analyse various two wheelers and its technology along with its functions.
- Design power plant for different applications.
- Design and analyse transmission units used in two wheelers.
- Analyse different frames and suspension system used in two wheelers.
- Through knowledge on various three wheelers.

REFERENCES:

1. Modern motor cycle technology by Edward Abdo 3rd Edition, 2015
2. Two Wheelers and Three Wheelers, By K. K. Ramalingam, Scitech publications, 2017.
3. Motorcycle handling and chassis design, By Tony Foale, 2nd Edition, 2006
4. Motorcycle Dynamics, By Vittore Cossalter 2nd Edition, 2006
5. Irving,P.E., Motor cycle Engineering, Temple Press Book, London, 1992.
6. Motorcycle Basics Tech book by Haynes 2nd Edition, 2015
7. Build Your Own Electric Motorcycle, By Carl Vogel,2009

AM5008 ALTERNATIVE FUELS AND PROPULSION SYSTEMS L T P C

3 0 0 3

OBJECTIVES

- To acquire knowledge on availability of renewable fuels in the world and the technologies used for biofuel production
- To understand the challenges and difficulties involved in using alternative fuels in internal combustion engines
- To acquire complete knowledge on availability of possible alternate fuels and their properties to use as fuel in CI and SI engines
- 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
- 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.

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.

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.

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.

TOTAL 45 PERIODS

OUTCOMES

- Upon completion the course the students will have the complete knowledge on possible bio fuel production methods and their properties in detail.
- They will be able to apply their knowledge in making changes in engine design and fuel modification for the utilizing liquid alternative fuels effectively in the engines.
- They will be able to demonstrate the engines operation with new fuels and methods
- They further will innovate methods and design changes for optimal use of liquid alternative fuels in conventional engines
- They will be able to apply knowledge in using all the renewable gaseous fuels in IC engines with superior engine operation.

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.

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AM5009 HYDRAULIC AND PNEUMATIC SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of hydraulic and pneumatic systems
- To examine the working of hydraulic power drives
- To apply knowledge on fluid power elements
- To design hydraulic and pneumatic systems.
- To evaluate the concept 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.

UNIT V AUTOMOTIVE APPLICATIONS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

- Understand the basics of hydraulic and pneumatic systems
- Examine the working of hydraulic power drives
- Apply knowledge on fluid power elements
- Design hydraulic and pneumatic systems.
- Evaluate the concept of programming in PLC circuits.

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.

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4. Majumdar, S.R., “Oil Hydraulic Systems: Principles and Maintenance”, Tata McGraw- Hill Publishing Company Ltd., New Delhi, Fourth Reprint, 2003.
5. Peter Rohner, “Fluid Power Logic Circuit Design – Analysis, Design Method and Worked Examples”, The Macmillan Press Ltd., UK, 1979.
6. Andrew Parr, “Hydraulic and Pneumatics”, Jaico publishing house, 1999.

AM5010 IC ENGINE PROCESS MODELING L T P C
3 0 0 3

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 modeling 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.

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 PERIODS

OUTCOMES

1. Students will 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.
2. They will be able to calculate the heat of reaction, fuel air ratio and flame temperature for developing a thermodynamic engine model
3. They will acquire knowledge on the detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation of SI engine.
4. Students will become familiar with the modeling of progressive combustion and gas exchange processes and ability to build up control-oriented simulation model of internal combustion engines
5. They will get familiarized with the essential models of engine cycle simulation and theoretical knowledge to control the calculation accuracy and calculation efficiency of engine performance, combustion and emission.

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.

AM5011 VEHICLE CONTROL SYSTEMS L T P C
3 0 0 3

OBJECTIVES

- To understand the basics of control system used in automobiles
- To recognize the electronically controlled system used in driving mechanics.
- To understand the working principle of driver modelling and power train control systems.
- To identify the control system used in hybrid and electrical vehicles.
- 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.

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UNIT IV COMFORT SYSTEM **9**

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

UNIT V INTELLIGENT TRANSPORTATION SYSTEM **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the basics of control system used in automobiles
- Recognize the electronically controlled system used in driving mechanics.
- Understand the working principle of driver modelling and power train control systems.
- Identify the control system used in hybrid and electrical vehicles.
- 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.

AM5012 ROAD VEHICLE AERODYNAMICS **L T P C**
3 0 0 3

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

Introduction, Properties of Incompressible Fluids, External Flow Phenomena Related to Vehicles, Aerodynamic Forces and Moments, Resistances to Vehicle Motion, Performance, Fuel Consumption and Fuel Economy, Strategy for Lowest Fuel Consumption.

UNIT II AIR RESISTANCE ON PASSENGER CARS **9**

Car as a Bluff Body, Drag and Lift, Drag Fractions and Their Local Origins - Front End, Windshield and A-Pillar, Roof, Rear End, Plan View and Side Panels, Underbody, Wheels and Wheel Housings, Front Spoiler, Rear Spoiler. Strategies for Body Shape Development – Objectives, Detail Optimization, Shape Optimization, Facelift, Spoilers.

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

Relation between Tractive Resistance, Drag Reduction and Fuel Consumption, Aerodynamic Drag Coefficients of Various Commercial Vehicles, Drag Minimization on Trucks, Buses. Add-on devices for drag reduction. Reduction of Vehicle Soiling, Water accumulation on windshield and windows.

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 **WIND TUNNELS, MEASUREMENT AND TEST TECHNIQUES** **9**

Fundamentals of Wind Tunnel Technique, Tests with Reduced-Scale Models - Details of Model Construction and Test Technique, Reynolds Number Effects, Climatic Tunnels. Measuring Equipment and Transducers – Flow visualization techniques, Measurement of Aerodynamic Forces and Moments, Pressure Measurements, Measurement of the Airflow Velocity, Temperature Measurement.

TOTAL: 45 PERIODS

OUTCOMES

1. Knowledge upon the forces & moments influencing drag.
2. Solve exercises related to fuel economy & drag.
3. Appraise upon the techniques of shape based optimization practiced in industry.
4. Awareness about the influence of rider position in motorcycle aerodynamics.
5. Expose to fundamentals of Experimental testing.

REFERENCES:

1. Hucho. W.H. – “Aerodynamic of Road Vehicles – From Fluid Mechanics to Vehicle Engineering” , Society of Automotive Engineers, U.S, Fourth edition.
2. R.H.Barnard - “Road vehicle aerodynamic design, An Introduction” , Mechaero publications, Third edition, 2010
3. T. Yomi Obidi - “Theory and Applications of Aerodynamics for Ground Vehicles” , SAE International, 2014
4. Alan Pope, Jewel B. Barlow, William H. Rae “Low speed wind tunnel testing” , John Wiley & Sons, Third edition, 1998

AM5013 **ELECTRIC AND HYBRID VEHICLES** **L T P C**
3 0 0 3

OBJECTIVES:

The course should enable the students to:

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** **10**

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 SOURCES** **9**

Battery Parameters- - Different types of batteries – Lead Acid- Nickel based-Sodium based-Lithium based- Metal Air based. Battery Modeling- Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System

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 8

Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles. Steering and Suspension system. Choice of Tires.

TOTAL : 45 PERIODS

OUTCOMES:

The students will able to

- Understand working of different configurations of hybrid and electric vehicles
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
- Choose proper energy storage systems for vehicle applications
- Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
- Understand basic operation of power-split device in hybrid electric vehicle.

REFERENCES:

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

4. Ron HodKinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication, 2005

5. Lino Guzzella, " Vehicle Propulsion System" Springer Publications,2005

AM5014 VEHICLE MAINTENANCE L T P C

3 0 0 3

OBJECTIVES:

To import knowledge on

- To give knowledge on the importance of vehicle maintenance
- To impart knowledge on sub systems of engine and chassis and its maintenance
- To understand different transmission systems and its maintenance
- To understand vehicle body structure and its maintenance
- To understand the function of various electrical and electronic units and its maintenance

UNIT I MAINTENANCE RECORDS, BASIC TOOLS AND INSTRUMENTS 9

Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Log books. Trip sheet. Lay out and requirements of maintenance shop. Standard tool set, torque wrenches, compression and vacuum gauges, OBD Tool, gauges for engine tune up.

UNIT II POWER PLANT REPAIR AND OVERHAULING 9

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

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UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS 9

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

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY 9

Body panel tools for repairing. Tinkering and painting. Minor and major repairs. Door lock and window glass actuating system maintenance.

UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL AND ELECTRONIC SYSTEMS 9

Maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator, regulator, lighting system, horn and dash board instruments. Introduction to OBD.

TOTAL : 45 PERIODS

OUTCOMES:

Upon the completion of the course student can able to understand

- the importance of maintenance
- various sub systems of vehicle and its maintenance Understand Transmission
- functions of transmission and its maintenance
- the importance of vehicle body structure
- Basic functional principle of electrical and electronic gadgets in automobile and its maintenance

REFERENCES:

1. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London , 1969.
2. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi, 1986.
3. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B.
4. Taraporevala Sons, Bombay, 1963
5. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.
6. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953.
7. A,W.Judge, Maintenance of high speed diesel engines, Chapman Hall Ltd., London, 1956.
8. V.L.Maleev, Diesel Engine operation and maintenance, McGraw Hill Book CO., Newyork,1995.

AM5015 PRODUCTION OF AUTOMOTIVE COMPONENTS L T P C
3 0 0 3

OBJECTIVES:

- To compare and analyse the different casting process
- To design various machining process according to the requirement
- Analysis of suitable process related to forming
- To differentiate the effect of powder metallurgy on selective components
- To impart knowledge on recent trends of automotive components

UNIT I CASTING 10

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

UNIT III FORGING AND EXTRUSION PROCESS 10

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

UNIT IV POWDER METALLURGY AND PROCESSING OF PLASTICS 6

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

UNIT V RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS 10

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

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

AM5016 **VEHICLE AIR CONDITIONING SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES

- To impart the knowledge on automotive air-conditioning and its components functions
- To understand the Psychometric concepts, refrigerant characteristics,
- To understand the range of techniques that can be used in diagnosing
- To identify faults which affect automotive air-conditioning system performance
- To provide adequate knowledge in safe working practice. understanding the correct procedures for A/C service and repair

UNIT I FUNDAMENTALS **9**

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

UNIT II REFRIGERANTS & AIR MANAGEMENT SYSTEMS **9**

Refrigerants: Temperature and pressure relation, Properties of R-12 and R134a- refrigerant oil. Simple problems -Containers - Handling refrigerants - Tapping into the refrigerant container - Ozone Layer Depletion. Air management system: Air routing for manual, semi and automatic system- cases and ducts- Air distribution, control head and doors- Defrost system

UNIT III AUTOMATIC CLIMATE CONTROL SYSTEM **9**

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

UNIT IV DESIGN OF AIR-CONDITIONING COMPONENTS **9**

Modeling of Fixed and variable Displacement type compressor, evaporator modeling – heat transfer correlations for the fluids inside the evaporator, analysis of evaporator frosting- condenser modeling - improvement of refrigerant flow control method.

UNIT V AIR CONDITIONING DIAGNOSIS AND SERVICES **9**

AC system diagnosis based on temperature and pressure measurements, sight glass, sound etc. - refrigerant leak detection- Trouble shooting and Servicing of compressor, evaporator, condenser, heater core – HVAC equipment , recovery and charging. Air routing system service.

TOTAL: 45 PERIODS

OUTCOMES:

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

REFERENCES :

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

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4. Steven Daly “Automotive Air Conditioning and Climate Control System”, Butterworth-Heinemann., 2006
5. Paul Weiser, “Automotive air conditioning”, Reston Publishing Co Inc., 1990.
6. James D. Halderman, “Automotive Heating, Ventilation, and Air Conditioning Systems”,
7. Pearson Education Inc., 2004.

AM5017 AUTOMOTIVE SAFETY L T P C
3 0 0 3

OBJECTIVES:

The course should enable the students:

- To introduce vehicle structural crashworthiness and crash testing
- To introduce pedestrian safety
- To get the knowledge in sensors provided in the vehicle to avoid the crash and to detect the obstacles around the vehicle.
- To understand the fundamentals of sensor data fusion as it relates to ADAS.
- To Understand the concept of the connected vehicle and its role in ADAS and automated vehicles.

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.

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 control 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 NAVIGATION SYSTEM 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

OUTCOMES:

The students should be able to:

- Know about the design of the bumper for safety.
- Know about the concept of crumble zone, and also the effect of acceleration and deceleration of the vehicle in the compartment of the vehicle.
- Know the various types of safety aspects such as active and passive safety, the active safety components and the working passive safety components such as air bags, seatbelts
- Understand the fundamentals of sensor data fusion as it relates to ADAS.
- Understand the concept of the connected vehicle and its role in ADAS and automated vehicles.

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REFERENCES:

1. ARAI Safety standards
2. Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.
3. Ljubo Vlacic, Michel Parent, Fumio Harashima – “Intelligent Vehicle Technologies Theory and Applications” -Butterworth-Heinemann, 2001
4. Marek .J, H.-P. Trah, Y. Suzuki, I. Yokomori - “Sensors for Automotive Applications “ - WILEY-VCH Verlag GmbH & Co. 2003
5. Robert Bosch GmbH - “Safety, Comfort and Convenience Systems”- Wiley; 3rd edition , 2007
6. Surface Vehicle Recommended Practice - SAE J 3016-2018 , SAE International ,2018

AM5018	ENGINE COMBUSTION THERMODYNAMICS AND ENGINE HEAT TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVES

1. To develop the students, understand the thermodynamic principles of general and engine combustion.
2. To acquire knowledge in chemical kinetics involved in general and engine combustion
3. To study different types of flames, their structures and analyze the factors affecting on them.
4. To demonstrate the importance of engine heat release rate and heat transfer models for engine combustion analysis.
5. To acquire knowledge in experimental methods for combustion and heat transfer calculations to apply in engines 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 – Heat release – Gas temperature – 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 – P-θ diagrams in SI and CI engines, Assembly – Temperature measurement in piston – cylinder liner – Cylinder head and engine valves.

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TOTAL 45 PERIODS

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OUTCOMES:

1. Upon completion the students summarize the thermodynamic principles of general and engine combustion.
2. They understand the principle of engine combustion and the various heat transfer models and measuring methods of engine heat transfer in detail
3. They will have comment over on different flames and their importance in combustion applications
4. They will understand thermodynamics of combustion, grasp the knowledge of normal, abnormal combustion and heat transfer in engines
5. 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.

AM5019	THEORY OF FUELS AND LUBRICANTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify the processes behind fuel extraction system.
- To understand the theory behind lubrication
- To study the properties of lubricants.
- To elaborate the properties of fuels used in IC engines.
- 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 basestocks, 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 Additives and additive mechanism, for lubricants. Introduction to Nano fluids

TOTAL : 45 PERIODS

OUTCOMES:

- Identify the processes behind fuel extraction system.
- Understand the theory behind lubrication
- Study the properties of lubricants.
- Elaborate the properties of fuels used in IC engines.
- Understand the need of fuel rating.

REFERENCES

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

OPEN ELECTIVE COURSES (OEC)

OE5091	BUSINESS DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.

3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

OE5092 INDUSTRIAL SAFETY L T P C
3 0 0 3

COURSE OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive

maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn ,Foundation Engineering Handbook, Chapman & Hall London,2013.
4. Higgins & Morrow , Maintenance Engineering Handbook, Eighth Edition,2008

OE5093 OPERATIONS RESEARCH L T P C
3 0 0 3

COURSE OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation , assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method, Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III **9**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING *CONCEPTS* **9**

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT **9**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

Attested

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UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL HOURS: 45

OUTCOMES

CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095 COMPOSITE MATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

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UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5				✓	✓		✓					

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

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OE5096 **WASTE TO ENERGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNITI INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNITII BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNITV BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓

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CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

COURSE OBJECTIVES:

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AX5092 DISASTER MANAGEMENT L T P C
2 0 0 0

COURSE OBJECTIVES:

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES:

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C

2 0 0 0

COURSE OBJECTIVES:

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS 6

Alphabets in Sanskrit

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UNIT II TENSES AND SENTENCES 6

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

COURSE OUTCOMES:

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX5094 VALUE EDUCATION L T P C
2 0 0 0

COURSE OBJECTIVES:

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Students will be able to

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

Suggested reading

1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AX5095 CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat.

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Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096 PEDAGOGY STUDIES L T P C
2 0 0 0

COURSE OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT III THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

Attested

UNIT IV EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

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Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT V PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT VI RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097 STRESS MANAGEMENT BY YOGA

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COURSE OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Attested

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Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayama

TOTAL: 30 PERIODS

COURSE OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

COURSE OBJECTIVES:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010

Approved

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2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.