KUMARAGURU COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641049

REGULATIONS 2015

CURRICULUM AND SYLLABUS

III - VIII Semesters

B.E., AUTOMOBILE ENGINEERING

Department of Automobile Engineering

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DEPARTMENT OF AUTOMOBILE ENGINEERING

Vision

To be a renowned Learning Centre in the field of Automobile Engineering contributing towards development of the society.

Mission

- Develop students for successful careers in Industry, and Academia.
- Provide required learning environment and processes to become socially responsible Engineering Professionals.
- Establish Industry-Institute interaction.
- Inculcate the entrepreneurial mind set among the students.

Program Educational Objectives (PEO's)

Graduates will be able to

1. Design and develop products, utilize their knowledge and skills as engineer / start their own ventures as entrepreneurs
2. Practice managerial leadership roles with values and social responsibility.
3. Pursue higher studies and research in core, allied fields and management.

Program Outcomes (PO's)

The following are the program outcomes:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO's)

Graduates will be able to

PSO 1: provide solutions for designing safe and affordable automotive and mobile equipment.

PSO 2: explore the Automotive Manufacturing, Automotive Electrical & Electronics, vehicle maintenance and service domains.

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Kumaraguru College of Technology

Coimbatore – 641 049

CURRICULUM 2015

B.E.-Automobile Engineering

Semester - 3

S.No	Course Code	Course Title	Category	Contact Hours	Hrs/Week &Credits				Pre-requisites
					L	T	P	**C**	
Theory									
1	U15MAT301	Numerical Methods	BS	5	3	2	0	4	
2	U15AUT301	Automotive Chassis	PC	3	3	0	0	3	
3	U15AUT302	Thermodynamics and Thermal Engineering	ES	5	3	2	0	4	
4	U15AUT303	Manufacturing Technology	PC	3	3	0	0	3	
5	U15AUT304	Materials and Metallurgy	PC	3	3	0	0	3	
6	U15AUT305	Strength of Materials	ES	5	3	2	0	4	
Practical									
7	U15AUP301	Automotive Chassis and Engine Components Laboratory	PC	2	0	0	2	1	
8	U15AUP302	Manufacturing Technology Laboratory	PC	2	0	0	2	1	
9	U15AUP303	Automotive Component Modeling Laboratory	PC	2	0	0	2	1	
10	U15GHP301	Family Values	HS	2	0	0	2	1	
Total				32	18	6	8	**25**	

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Semester - 4									
S.No	Course Code	Course Title	Category	Contact Hours	Hrs/Week &Credits				Pre-requisites
					L	T	P	C	
Theory									
1	U15AUT401	Fluid Mechanics and Machinery	ES	5	3	2	0	4	
2	U15AUT402	Mechanics of Machines	PC	5	3	2	0	4	
3	U15AUT403	Automotive Engines	PC	3	3	0	0	3	
4	U15AUT404	Modeling and Simulation of Automotive Systems	PC	5	3	2	0	4	
5	U15EST003	Environmental Science and Engineering	HS	3	3	0	0	3	
Practical									
6	U15AUP401	a) Strength of Materials Laboratory b) Fluid Mechanics & Machinery Laboratory	ES	2	0	0	2	1	
7	U15AUP402	a) Fuels and Lubricants Laboratory b) Engine Performance and Emission Testing Laboratory	PC	2	0	0	2	1	
8	U15ENP401	Communication Skills Laboratory	EEC	2	0	0	2	1	
9	U15CSP204	Problem Solving Techniques	EEC	3	1	0	2	2	
10	U15GHP401	Professional Values	HS	2	0	0	2	1	
Total				32	16	6	10	**24**	

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Semester - 5									
S.No	Course Code	Course Title	Category	Contact Hours	Hrs/Week &Credits				Pre-requisites
					L	T	P	C	
Theory									
1	U15AUT501	Automotive Engine Systems	PC	3	3	0	0	3	
2	U15AUT502	Machine Component Design	PC	5	3	2	0	4	
3	U15AUT503	Automotive Electrical and Electronics	PC	3	3	0	0	3	
4	U15AUT504	Finite Element Analysis	PC	5	3	2	0	4	
5	PE1	Professional Elective -I	PE	3	3	0	0	3	
6	OE1	Open Elective - I	OE	3	3	0	0	3	
Practical									
7	U15AUP501	Automotive Electrical & Electronics Laboratory	PC	2	0	0	2	1	
8	U15AUP502	Automotive Component Analysis Laboratory	PC	2	0	0	2	1	
9	U15AUP503	Technical Seminar	EEC	2	0	0	2	1	
10	U15GHP501	Social Values	HS	2	0	0	2	1	
Total				30	18	4	8	**24**	

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Semester - 6									
S.No	Course Code	Course Title	Category	Contact Hours	Hrs/Week &Credits				Pre-requisites
					L	T	P	**C**	
Theory									
1	U15AUT601	Chassis and Engine Component Design	PC	5	3	2	0	4	
2	U15AUT602	Vehicle Dynamics	PC	5	3	2	0	4	
3	U15AUT603	Automotive Sensors and Embedded Systems	PC	3	3	0	0	3	
4	U15AUT604	Automotive Transmission	PC	3	3	0	0	3	
5	PE2	Professional Elective II	PE	3	3	0	0	3	
6	OE2	Open Elective II	OE	3	3	0	0	3	
Practical									
7	U15AUP601	Vehicle Dynamics Laboratory	PC	2	0	0	2	1	
8	U15AUP602	Advanced Automotive Systems Laboratory	PC	2	0	0	2	1	
9	U15AUP603	Mini Project	EEC	2	0	0	2	1	
10	U15GHP601	National Values	HS	2	0	0	2	1	
Total				30	18	4	8	**24**	

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Semester - 7									
S.No	Course Code	Course Title	Category	Contact Hours	Hrs/Week &Credits				Pre-requisites
					L	T	P	**C**	
Theory									
1	U15AUT701	Vehicle Body Engineering	PC	3	3	0	0	3	
2	U15GST006	Product Design and Development	EEC	3	3	0	0	3	
3	PE3	Professional Elective III	PE	3	3	0	0	3	
4	PE4	Professional Elective IV	PE	3	3	0	0	3	
5	OE3	Open Elective III	OE	3	3	0	0	3	
Practical									
7	U15AUP701	Vehicle Maintenance and Testing Laboratory	PC	2	0	0	2	1	
8	U15AUP702	Project Phase – I	EEC	4	0	0	4	2	
9	U15AUP703	Technical & Research Skills Development	EEC	2	0	0	2	1	
10	U15GHP701	Global Values	HS	2	0	0	2	1	
Total				25	15	0	10	**20**	

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Semester - 8									
S.No	Course Code	Course Title	Category	Contact Hours	Hrs/Week &Credits				Pre-requisites
					L	T	P	**C**	
Theory									
1	PE5	Professional Elective - V	PE	3	3	0	0	3	
2	PE6	Professional Elective - VI	PE	3	3	0	0	3	
Practical									
3	U15AUP801	Project Phase II	EEC	20	0	0	20	10	
Total				26	6	0	20	**16**	

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Professional Electives (PE)									
S.No	Course Code	Course Title	Category	Contact Hours	Hrs/Week &Credits				Pre-requisites
					L	T	P	C	
1	U15AUTE01	Automotive Aerodynamics	PE	3	3	0	0	3	
2	U15AUTE02	Computational Fluid Dynamics	PE	3	3	0	0	3	
3	U15AUTE03	Vehicle Concept Design and Styling	PE	3	3	0	0	3	
4	U15AUTE04	Design for Manufacture and Assembly	PE	3	3	0	0	3	
5	U15AUTE05	Computer Simulation of IC Engine Processes	PE	3	3	0	0	3	
6	U15AUTE06	Noise, Vibration and Harshness	PE	3	3	0	0	3	
7	U15AUTE07	Combustion Engineering	PE	3	3	0	0	3	
8	U15AUTE08	Alternate Fuels	PE	3	3	0	0	3	
9	U15AUTE09	Hydraulic and Pneumatic Systems	PE	3	3	0	0	3	
10	U15AUTE10	Composite Materials and Structures	PE	3	3	0	0	3	
11	U15AUTE11	Automotive Components Manufacturing	PE	3	3	0	0	3	
12	U15AUTE12	Unconventional Machining Processes	PE	3	3	0	0	3	
13	U15AUTE13	Additive Manufacturing and Tooling	PE	3	3	0	0	3	
14	U15AUTE14	Heat Transfer	PE	3	3	0	0	3	
15	U15AUTE15	Design of Jigs, Fixtures and Press tools	PE	3	3	0	0	3	
16	U15AUTE16	Virtual Instrumentation	PE	3	3	0	0	3	

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17	U15AUTE17	Automotive HVAC	PE	3	3	0	0	3	
18	U15AUTE18	Microprocessor Based System Design	PE	3	3	0	0	3	
19	U15AUTE19	Tyre Technology	PE	3	3	0	0	3	
20	U15AUTE20	Vehicle Testing and Validation	PE	3	3	0	0	3	
21	U15AUTE21	Vehicle Troubleshooting and Maintenance	PE	3	3	0	0	3	
22	U15AUTE22	Measurements and Metrology	PE	3	3	0	0	3	
23	U15AUTE23	Special Purpose Vehicles	PE	3	3	0	0	3	
24	U15AUTE24	Entrepreneurship Development	PE	3	3	0	0	3	
25	U15AUTE25	Project Management	PE	3	3	0	0	3	
26	U15AUTE26	Quality Control and Reliability	PE	3	3	0	0	3	
27	U15AUTE27	Modern Automobile Accessories	PE	3	3	0	0	3	
28	U15AUTE28	Advanced Automotive Systems	PE	3	3	0	0	3	
29	U15AUTE29	Automotive Safety	PE	3	3	0	0	3	
30	U15AUTE30	Automotive Pollution and Control	PE	3	3	0	0	3	
31	U15AUTE31	Intellectual Property Rights, Innovation and Technology	PE	3	3	0	0	3	
32	U15AUTE32	Vehicle Transport Management	PE	3	3	0	0	3	
33	U15AUTE33	Hybrid, Electric and Fuel-cell Vehicles	PE	3	3	0	0	3	

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34	U15AUTE34	Fuel Cell Technology	PE	3	3	0	0	3	
35	U15AUTE35	Product Engineering	PE	3	3	0	0	3	
36	U15AUTE36	Fuels and Lubricants	PE	3	3	0	0	3	
37	U15AUTE37	Engineering System Analysis	PE	3	2	0	2	3	
37	U15GST002	Total Quality Management	PE	3	3	0	0	3	
38	U15GST003	Principles of Management	PE	3	3	0	0	3	
39	U15GST004	Operations Research	PE	3	3	0	0	3	
40	U15GST005	Engineering Economics and Financial Management	PE	3	3	0	0	3	
41	U15GST008	Foundation Skills in Integrated Product Development (FSIPD)	PE	3	3	0	0	3	
42	U15GST007	Professional Ethics	PE	3	3	0	0	3	

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Open Electives (OE)									
S.No	Course Code	Course Title	Category	Contact Hours	Hrs/Week &Credits				Pre-requisites
					L	T	P	C	
1	U15AUOE01	Automotive Engineering	OE	3	3	0	0	3	--
2	U15AUOE02	Electric and Hybrid Vehicles	OE	3	3	0	0	3	--
3	U15AUOE03	Automotive Electronic Systems	OE	3	2	0	2	3	--
4	U15AUOE04	Vehicle Dealership Management	OE	3	3	0	0	3	--
5	U15AUOE05	Design of Automotive Electronic Control Unit (ECU)	OE	3	3	0	0	3	--
6	U15AUOE06	Automotive Ergonomics	OE	3	3	0	0	3	--

ONE CREDIT COURSES

Course Code	Course Title
U15AU*I*N01	Overview of Motorsports Engineering
U15AU*I*N02	Automotive Styling
U15AU*I*N03	Electronic Engine Management Systems
U15AU*I*N04	Vehicle Service Management
U15AU*I*N05	Vehicle Maintenance
U15AUIN06	Intellectual Property Rights
U15AUIN07	Lean manufacturing and six sigma
U15AUIN08	Off Road Vehicle
U15AUIN09	Industrial Safety
U15AUIN10	Commercial Vehicle Technologies

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SEMESTER III

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U15MA*T*301 NUMERICAL METHODS

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Solve a set of algebraic equations representing steady state models formed in engineering problems[K3]

CO2: Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables[K3]

CO3: Find the trend information from discrete data set through numerical differentiation.

CO4: Estimate integrals from discrete data through numerical methods.

CO5: Predict the system dynamic behaviour through solution of ODEs modeling the system

CO6: Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.

Pre-requisite:

1. Basic knowledge in differentiation, integration and numerical operations.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S							M	M			S	
CO2	S	S							M	M			S	
CO3	S	S							M	M			S	
CO4	S	S							M	M			S	
CO5	S	S							M	M			S	
CO6	S	S							M	M			S	

Course Assessment methods:

Direct	Indirect
1. Internal Test-I	1. Course End Survey
2. Internal Test-II	
3. Assignment	
4. Tutorial	
5. End semester exam	

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NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS

9+6 Hours

Solution of nonlinear equations: False position method, Fixed point iteration method, Newton Raphson method for a single equation and a set of non- linear equations - Solution of linear system of equations: Gaussian elimination method, Gauss Jordan method and Gauss Seidel method - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method.

CURVE FITTING AND INTERPOLATION **9+6 Hours**

Curve fitting: Method of least squares – Interpolation: Newton's forward and backward difference formulae – Divided differences – Newton's divided difference formula - Lagrange's interpolation – Inverse interpolation.

NUMERICAL DIFFERENTIATION AND INTEGRATION **9+6 Hours**

Numerical differentiation by using Newton's forward, backward and divided differences – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules– Truncation error – Evaluation of double integrals.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION **9+6 Hours**

Single step methods: Taylor's series method, Euler and Improved Euler methods, Fourth order Runge – Kutta method – Multistep method: Milne's predictor - corrector method.

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS **9+6 Hours**

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain– Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one dimensional wave equation by explicit scheme.

Theory :45 Hrs **Tutorial: 30 Hrs** **Total Hours: 75**

References:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2007.
2. Steven C.Chapra and Raymond P. Canale, "Numerical Methods for Engineers with Programming and Software Applications", McGraw-Hill, 2004.
3. Gerald C. F. and Wheatley P.O, "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 2002.
4. Sastry S.S, "Introductory Methods of Numerical Analysis", Prentice Hall of India Pvt Ltd, New Delhi, 2003.

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U15AU*T*301 AUTOMOTIVE CHASSIS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the construction details of various types of automotive chassis and basic functions of subsystems in the chassis.

CO2: Distinguish various types of drive line, suspension system, brake system, steering system and wheels & tyres in the vehicles.

CO3: Apply the knowledge for selection of suitable subsystems for a vehicle.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W	W	W			W						M	S	M
CO2	W	W	S			W						M	S	M
CO3	M	M	S			W						S	S	

Course Assessment methods:

Direct	Indirect
1. Continuous assessment tests	1. Course Exit Survey
2. Assignments	
3. End-semester Examinations	

INTRODUCTION **9 Hours**

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames, Types of Front Axles and Stub Axles, Front Wheel Geometry, namely, Castor, Camber, King Pin Inclination and Toe–in, Ackerman's and Daut's Steering Mechanisms, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power–Assisted Steering.

DRIVE LINE **9 Hours**

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Multi–axle vehicles, Differential principle and types, Differential housings, Non–Slip differential, Differential locks.

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AXLES 9 Hours

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

SUSPENSION SYSTEM 9 Hours

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, Boggy suspension system, Independent Suspension System, Shock Absorbers, Types and Constructional details.

BRAKING SYSTEM 9 Hours

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

Theory :45 Hrs **Total Hours: 45**

References:

1. Kripal Singh, "Automobile Engineering" ,Standard Publishers,2011
2. R.K. Rajput, "A Text–Book of Automobile Engineering", Laxmi Publications Pvt.Ltd,2007.
3. N.K. Giri, "Automotive Mechanics" Khanna Publishers, New Delhi, 2005.

Other references:

1. Heldt P.M., "Automotive Chassis" Chilton Co., New York,1990.
2. Newton Steeds and Garret, "Motor Vehicles" 13th Edition, Butterworth, London, 2005.
3. Heinz Hazler, "Modern Vehicle Technology", Butterworth, London, 2005.

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U15AU*T*302 **THERMODYNAMICS AND THERMAL ENGINEERING**

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the basics and laws of thermodynamics with respect to heat engines and thermal equipment.

CO2: Apply the knowledge of behavior of working fluids in various thermodynamic equipment.

CO3: Understand various Air Standard Cycles analysis for thermal devices

CO4 : Understand Refrigeration and Air conditioning systems

CO5 : Understand the modes of heat transfer

CO6 : Understand various types of heat exchangers' application

Pre Requisite: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	M			M						M	S	M
CO2	S	M	M			M						M	S	M
CO3	S	M	M			M						M	S	
CO4	S	M	M			M						M	S	W
CO5	S	M	M			M						M	S	W
CO6	S	M	M			M						M	S	M

Course Assessment methods:

Direct	Indirect
1. Internal Test	1. Course Exit Survey
2. Assignment/Presentation/Seminar/Quiz	2. GATE Score
3. Semester Exam	

BASIC THERMODYNAMICS **10+6 Hours**

Systems, Zeroth low, First law. Steady flow energy equation. Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement – Clausius statement – Concept of Entropy, Clausius inequality, Entropy change in non-flow processes. Properties of gases and vapours.

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AIR STANDARD CYCLES AND COMPRESSORS 9+6 Hours

Otto, Diesel and Dual combustion. Air standard efficiency. Mean effective pressure, Reciprocating compressors. Intercooling – Minimum work requirement

STEAM AND JET PROPULSION 8+6 Hours

Properties of steam — Simple Rankine cycle Efficiency of Rankine cycle - Brayton cycle –Gas Turbine - Simple jet propulsion system

REFRIGERATION AND AIR-CONDITIONING 9+6 Hours

Principles of Psychrometry and refrigeration – Vapour compression – Vapour absorption types – Co-efficient of performance, Properties of refrigerants – Basic Principle and types Air conditioning, introduction to HVAC and its applications in automotive.

HEAT TRANSFER 9+6 Hours

Modes of Heat Transfer – Conduction, Convection and Radiation. Basics of Conduction in parallel, radial and composite wall – Basics of Convective heat transfer – Fundamentals of Radiative heat transfer. Introduction to Heat Exchanger.

Theory :45 Hrs **Tutorial: 30 Hrs** **Total Hours: 75**

References:

1. Nag.P.K., “Engineering Thermodynamics”, Tata McGraw-Hill, New Delhi, 2007.
2. Rathakrishnan E., “Fundamentals of Engineering Thermodynamics”, Prentice-Hall India, 2005.
3. Ramalingam K.K. “Thermodynamics”, Sci-Tech Publications, 2006

Other references:

1. Holman.J.P., “Thermodynamics”, 3rd Ed. McGraw-Hill, 2007.
2. Venwylen and Sontag, “Classical Thermodynamics”, Wiley Eastern, 1987
3. Arora C.P, “ Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.
4. Merala C, Pother, Craig W, Somerton, “Thermodynamics for Engineers”, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
5. Holman.J.P., “Thermodynamics”, 3rd Ed. McGraw-Hill, 2007.

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U15AU*T*303 MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Casting processes used for automotive components manufacturing

CO2: Understand the Forming and Powder metallurgy processes used for automotive components manufacturing

CO3: Understand the Processes used for automotive components manufacturing

CO4: Understand the Conventional and Unconventional Machining processes used for automotive components manufacturing

CO5: Understand the Assembly processes used for automotive components manufacturing

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W		S		M									S
CO2	W		S		M									S
CO3	S		S		M									S
CO4	S		S		M									S
CO5	S		S		M									S

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment Test	1. Course Exit Survey
2. Assignments	
3. End Semester Examination	

CASTING **10 Hours**

Casting types, procedure to make sand mould, types of core making, moulding tolls, machine moulding, special moulding processes – CO_2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects, Application of Castings in Automobile.

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FORMING PROCESSES AND POWDER METALLURGY **10 Hours**

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Forming and Shaping of Plastics –Moulding Types, Thermoforming, Press forming Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy. Application of Forming, Hydro forming, Powder Metallurgy in Automobile.

WELDING **8 Hours**

Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing. Application of Welding in Automobile.

MACHINING **12 Hours**

Introduction to the Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan, Turret lathe CNC machines & Operations.

Principles and applications of the Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, and Electron beam machining and Laser beam machining. Application of Machining in Automobile

ASSEMBLY **3 Hours**

Assembly methods, straight assembly, group assembly, line balancing.

Theory :45 Hrs **Total Hours: 45**

References:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2. Nagendra Parashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hall of India Private Limited, 2007.
3. Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", 4/e, Pearson Education, Inc. 2007.
4. R.K.Jain and S.C. Gupta, "Production Technology", Khanna Publishers. 16th Edition, 2001.

Other references:

1. "H.M.T. Production Technology – Handbook", Tata McGraw-Hill, 2000.
2. Roy. A. Linberg, "Process and Materials of Manufacture", PHI, 2000.
3. M. Adithan and A.B. Gupta, "Manufacturing Technology", New Age, 2006

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MATERIALS AND METALLURGY

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the importance of engineering materials and their structures and Phase diagrams.

CO2: Understand the various heat treatments process

CO3: Understand the Testing of materials and its properties.

CO4: Understand about the Fe & Non-Fe alloys, Non-Metallic materials and Modern Materials

CO5: Select the materials for particular engineering application

Pre-requisite:

1. Engineering Physics, Material Science and Engineering Chemistry

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		M			W						M	S	M
CO2	M		M			M						M	M	S
CO3	M		M			W						M	M	M
CO4	M		M			M						M	S	S
CO5	S		M			M						M	S	S

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment Test	1. Course Exit Survey
2. Assignments	
3. End Semester Examination	

CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS **8 Hours**

Overview of crystal structures and defects, Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphism, eutectic, peritectic, eutectoid and peritectroid reactions, Iron – Iron carbide equilibrium diagram.

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HEAT TREATMENT **8 Hours**

Definition – Annealing, types – normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, types.

MECHANICAL PROPERTIES AND TESTING **6 Hours**

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy, fatigue and creep test.

FERROUS AND NON-FERROUS ALLOYS **8 Hours**

Composition, structure and properties of carbon steels - low alloy steels, stainless steels, tool steels, Cast irons - grey iron, ductile iron, white iron and malleable iron, Non-ferrous alloys - copper and copper alloys, aluminium and aluminium alloys, magnesium and magnesium alloys, nickel and nickel alloys and titanium and titanium alloys.

NON-METALLIC MATERIALS **8 Hours**

Polymeric materials - Formation of polymer structure - Properties and applications of engineering polymers - Advanced structure ceramics, WC, TiC, Al_2O_3, SiC, Si_2N_4, CBN and Diamond - Properties, processing and applications. Composite materials: Types, production techniques, structure, properties and applications.

MODERN MATERILAS **4 Hours**

Micro alloyed steels, High Strength Low alloy (HSLA) steel -Transformation induced plasticity (TRIP) steel, Maraging steel, Smart materials, Shape memory alloys Metallic glasses - Quasi crystals and nano crystalline materials.

APPLICATION OF MATERIALS **3 Hours**

Criteria of selecting materials for automotive components viz cylinder block, Cylinder head, piston, piston ring, Gudgeon pin, connecting rod, crank shaft, crank case, cam, cam shaft, engine valve, gear wheel , clutch plate, axle, bearings, chassis, spring, body panel, radiator, brake lining etc. Automotive technical textiles.

Theory :45 Hrs **Total Hours: 45**

References:

1. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.
2. William D Callsber “Material Science and Engineering”, John Wiley and Sons 1997.

Other references:

1. Raghavan.V.Materials Science and Engineering, Prentice Hall of India Pvt. Ltd., 1999
2. Sydney H.Avner “Introduction to Physical Metallurgy” McGraw-Hill Book Company, 1994.

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U15AU*T*305 STRENGTH OF MATERIALS

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the concepts of stress and strain
CO2: Analyze the beams of different cross sections for shear force and bending moment
CO3: Analyze the beams of different cross sections for slope and deflection
CO4: Understand the concepts necessary to design the structural elements and pressure vessels

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	M	M					W	W	W		M	
CO2	S	S	M	M					W	M	S		S	
CO3	S	S	M	M					W	M	S		S	
CO4	S	M	M	M					W	M	W		M	

Course Assessment methods:

Direct	Indirect
1. Assignments	1. Course Exit Survey
2. Internal Test	2. GATE Score
3. End Semester Examinations	

CONCEPT OF STRESSES AND STRAINS **10+6 Hours**

Concept of stress and strain, Hooke's law – Tension, Compression, and Shear, stress-strain diagram – Poisson's ratio, elastic constants and their relationship – Deformation of simple and compound bars. Thermal stresses – simple and Composite bars. Principal plane, principal stress, maximum shearing stress – Uniaxial, biaxial state of stress – Mohr's circle for plane stresses.

ANALYSIS OF BEAMS **9 +6 Hours**

Types of beams and loads – shear force and bending moment diagrams for cantilevers, simply supported and over hanging beams. Theory of pure bending- Bending stresses in simple and composite beams. Shear stress distribution in beams of different sections.

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DEFLECTION OF BEAMS **9 +6 Hours**

Slope and deflection of cantilever, simply supported beam by double integration method – Macaulay's method – Moment area method – Castigliano's theorem.

TORSION OF SHAFTS **8+6 Hours**

Theory of pure torsion, torsion of circular shafts and composite shafts.

COLUMNS AND CYLINDERS **9+6 Hours**

Columns and struts: Member subjected to combined bending and axial loads, Euler's theory, Crippling load, Rankine's theory.

Cylinders And Shells: Thin cylinder, thin spherical shells under internal pressure – Thick cylinders – Lame's equation – Shrink fit and compound cylinders.

Theory :45 Hrs **Tutorial: 30 Hr** **Total Hours: 75**

References:

1. Bansal R.K, "A Text Book of Strength of Materials", Lakshmi Publications Pvt. Limited, New Delhi, 2010.
2. Prabhu T.J, "Mechanics of solids", Private Publication, 2002.
3. Rajput R.K, "Strength of materials", Fourth Edition, S. Chand Limited, 2007.
4. Ferdinand P.Beer, and Rusell Johnston E, "Mechanics of Materials", SI Metric Edition, McGraw Hill, 2011.
5. William A. Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, McGraw Hill International Edition, 3rd Edition, 2007.

Other references:

1. Srinath L. S, "Advanced Mechanics of Solids", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
2. Egor P. Popov., "Engineering Mechanics Of Solids", 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2009.
3. James M. Gere, "Mechanics of Materials" Eighth Edition, Brooks/Cole, USA, 2013.
4. Shigley J. E, Applied Mechanics of Materials, International Student Edition, McGraw Hill Koyakusha Limited, 2000.

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U15AU*P*301 AUTOMOTIVE CHASSIS AND ENGINE COMPONENTS LABORATORY

L	T	P	C
0	0	2	1

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Dismantle & Assemble, Study the automobile chassis and engine components
CO2: Identify & differentiate components of SI & CI engines
CO3: Understand working of braking, steering, clutch, transmission, suspension systems.
CO4: Differentiate various subsystems of two, three & four wheeler vehicles

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W	S	M	W					M	M			S	M
CO2		S	M	W					M	M			S	M
CO3		S	M	W					M	M			S	
CO4		M	M	W					M	M			S	W

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment	1. Course Exit Survey
2. Model Practical Examinations	
3. End Semester Practical Examinations	

LIST OF EXPERIMENTS

AUTOMOTIVE CHASSIS LABORATORY

1. Study and Measurement of Automotive Chassis Frame
2. Performance test on Suspension Test Rig
3. Study, Dismantling and Assembling of Front Axle and Rear Axle
4. Study of Differential Unit & Calculation of Final Drive Ratio
5. Study of Steering Systems & Measurement of Steering Angle
6. Study of Braking Systems – Air brakes, Hydraulic Drum and Disc brakes
7. Study of different types of Clutch assembly

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ENGINE COMPONENTS LABORATORY

1. Dismantling of 4 cylinder petrol engine.
2. Assembling of 4 cylinder petrol engine.
3. Dismantling of 4 cylinder diesel engine.
4. Assembling of 4 cylinder diesel engine.
5. Study of oil filter, fuel filter, fuel injection system, carburetor, MPFI
6. Study of engine lubrication system components

(Note:Experiments beyond the syllabus should be conducted)

Total Hours 30

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U15AU*P*302

MANUFACTURING TECHNOLOGY LABORATORY

L	T	P	C
0	0	2	1

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Use of appropriate method, Tools and machine tools for performing Lathe operations

CO2: Use of appropriate method, Tools and machine tools for performing drilling operations

CO3: Use of appropriate method, Tools and machine tools for performing Shaping and grinding operations

CO4: Use of appropriate method, Tools and machine tools for manufacturing gears

CO5: Use of appropriate method, Tools and machine tools for performing Shaping and grinding operations

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		S			S	W			M	M				S
CO2		S			S	W			M	M				S
CO3		S			S	W			M	M				S
CO4		S			S	W			M	M				S
CO5		S			S	W			M	M				S

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment	1. Course Exit Survey
2. Model Practical Examinations	
3. End Semester Practical Examinations	

LIST OF EXPERIMENTS

1. LATHE
   - 1.1. Facing, plain turning and step turning
   - 1.2. Taper turning using compound rest.
   - 1.3. Taper turning using taper turning attachment
   - 1.4. Single start V thread, cutting and knurling
2. SHAPER AND SLOTTER
   - 2.1. Machining a V- block (in a Shaper)
   - 2.2. Machining internal key-way (in a Slotter)
3. DRILLING
   - 3.1. Drilling 4 or 6 holes at a given pitch circle on a plate
   - 3.2. Drilling, reaming and tapping
4. MILLING
   - 4.1. Plain Milling Exercise

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4.2. Gear Milling Exercise

5. GRINDING

5.1. Cylindrical Grinding Exercise

(Note:Experiments beyond the syllabus should be conducted)

Total Hours 30

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U15AU*P*303

AUTOMOTIVE COMPONENTS MODELING LABORATORY

L	T	P	C
0	0	2	1

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Modeling the Automotive components using design software

CO2: Assemble the Automotive components.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					M				M	W			S	
CO2					M				M	W			S	

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment	1. Course Exit Survey
2. Model Practical Examinations	
3. End Semester Practical Examinations	

LIST OF EXPERIMENTS

Part Design:

1. Piston
2. Connecting Rod
3. Crank shaft
4. Cam Shaft
5. Valve
6. Flywheel
7. Cylinder Block
8. Cylinder Head
9. Tyre & Rim
10. Clutch Components

Assembly Design:

1. Piston ,Connecting Rod and Crank shaft Assembly
2. Clutch Assembly

(Note:Experiments beyond the syllabus should be conducted)

Total Hours 30

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U15GH*P*301/ FAMILY VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	**1**	**0**	**0**	**1**

Objectives

1. To understand the importance of family and to contribute to it
2. To lead spiritual development through good family life.
3. To respect womanhood
4. To lead a healthy and disease free life

Course outcomes:

After successful completion of the course, the student would be able to:

1. The students shall understand the importance of a family
2. The students shall acquire skills in simplified Kundalini yoga for sound health.
3. The students shall learn about greatness of womanhood
4. The students shall learn about the importance of Blessings and relationship
5. The students shall know about simplified Kundalini yoga, its methodology and its benefits

Pre-requisite: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M		M	S	W		M		
CO2						S	M		W			S		
CO3						W						M		
CO4						M			M			S		
CO5						M						M		

Course Assessment methods:

Direct	Indirect
1.Individual Assignment	1.Attendance and Behavioural Assessment

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2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	

Introduction to Family Life – An Overall Perspective	1 Periods
Personal & Spiritual development through good Family life	1 Periods
Importance of Relationships & Blessings	3 Periods
Food as Medicine – Quantum Healing	3 Periods
Greatness of womanhood	2 Periods
Simplified Physical Exercises (Kundalini Exercises)	5 Periods

Total Periods: 15

References Books:

1. Vethathiri's Maharishi's, ***"Yoga for Modern Age"***, The World Community Service Centre, Vedhathiri Publications,2009.
2. Swami Vivekananda, "***The Man Making Message"*** The Ramakrishna Tapovanam, Published 1972.
3. Vethathiri's Maharishi's, ***"Manavalakalai part 1,2&3"*** 1^{1th} edition, The World Community Service Centre, Vethathiri Publications,2005.
4. Brian L Weiss, **" *Only Love is Real* "** by Grand Central Publishing, Published 1997.

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SEMESTER IV

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U15AU*T*401 **FLUID MECHANICS AND MACHINERY**

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the properties of the fluid.
CO2: Understand and solve the fluid flow problems.
CO3: Understand the mathematical techniques of practical flow problems.
CO4: Understand the energy exchange process in fluid machines.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	M	S					M	W			S	M
CO2	S	S	M	M					M	W			S	M
CO3	S	S	M	S					M	W			S	W
CO4	S	S	M	S					M	W			S	M

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Internal test	
3. End Semester Examination	

PROPERTIES OF FLUIDS AND FLUID STATICS **9+6 Hours**

Fluid properties: Mass density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, compressibility, surface tension and capillarity. Fluid statics: fluid pressure at a point, variation of pressure within a static fluid, hydrostatic law – Pressure head, Pascal's law. Measurement of pressure – Piezometric tube, manometry.

FLUID KINEMATICS AND FLUID DYNAMICS **10+6 Hours**

Fluid kinematics: Lagrangian and Eulerian description of fluid flow – Velocity and acceleration of fluid particles – Different types of fluid flow. Description of flow pattern: Stream line, streak line, path line. Principle of conservation of mass – Continuity equation.

Fluid dynamics: Euler's equation of motion along a streamline – Bernoulli's equation. Practical applications of Bernoulli's equation in flow measurement devices like venturimeter, orificemeter

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and pitot tube. Concept of impulse momentum equation & angular momentum principle with applications.

DIMENSIONAL AND MODEL ANALYSIS **8+6 Hours**

Dimensional analysis: dimensions, dimensional homogeneity, methods of dimensional analysis-Buckingham Pi theorem. Model analysis – Advantages and applications of model testing. Similitude, derivations of important dimensionless numbers, model laws.

FLOW THROUGH PIPES **8+6 Hours**

Laminar and turbulent flow characteristics, laminar flow through circular pipes – Hagen Poiseuille law, major and minor losses in pipes, pipe friction, Darcy – Weisbach equation, parallel, series and branched pipes.

HYDRAULIC MACHINES **10+6 Hours**

Hydraulic turbine: Classification, difference between impulse and reaction turbine.
Construction and working of Pelton turbine, Francis turbine and Kaplan turbine, velocity triangle, heads and efficiencies.
Pumps: classification, difference between positive and non-positive displacement pumps. Construction and working of reciprocating pump. Centrifugal pump-heads of a centrifugal pump, priming, velocity triangle, work done, efficiencies of centrifugal pump.

Theory :45 Hrs **Tutorial: 30 Hrs** **Total Hours: 75**

References:

1. Shames I H, 'Mechanics of Fluids', McGraw Hill Higher Education, 4th revised edition, 2002
2. R.K. Bansal – "Fluid mechanics and hydraulic machines," Laxmi Publications (P) Ltd, Ninth edition, 2015
3. Rajput R. K, "A text book of Fluid Mechanics and Hydraulic Machines", S. Chand & Company Ltd., New Delhi, Fourth edition, 2010.
4. Shiv Kumar, "Fluid Mechanics & Fluid Machines: Basic Concepts &Principles", Ane Books Pvt. Ltd., New Delhi, 2010.

Other references:

1. V.L. Streeter – "Fluid mechanics," McGraw-Hill, 1998
2. Rathakrishnan, E, 'Fundamentals of Fluid Mechanics', Prentice-Hall, 2007

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U15AU*T*402 MECHANICS OF MACHINES

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand and remember the fundamentals of various mechanisms, structures, inversion mechanisms, velocity and acceleration of simple mechanisms etc

CO2: Applying the knowledge for selecting the suitable drives like belt, ropes, pulleys etc.

CO3: Gear Train Calculation

CO4: Drawing the profile of cams and its analysis

CO5: Balancing of rotating and reciprocating masses

CO6: Analyzing the various vibrations in the moving components of a mechanism

Pre-requisite:

1. Engineering Mechanics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	W					M	M		M	S	M
CO2	S	M	S	M					M	M		M	S	M
CO3	S	S	S	W					M	M		M	S	
CO4	S	S	M	M					M	M		M	S	W
CO5	S	S	M	M					M	M		M	S	W
CO6	S	S	M	M					M	M		M	S	M

Course Assessment methods:

Direct	Indirect
1. Continuous assessment record	1. Course Exit Survey
2. Assignments	
3. End-semester examinations	

MECHANISMS 9+6 Hours

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom – Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

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FRICTION 9+6 Hours

Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

GEARING AND CAMS 9 +6 Hours

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicyclic gear trains – Determination of speed and torque- Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions.

BALANCING 9+6 Hours

Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi-cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method.

VIBRATION 9+6 Hours

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi-rotor systems – Geared shafts – Critical speed of shaft.

Theory :45 Hrs **Tutorial: 30 Hrs** **Total Hours: 75**

References:

1. Rattan S.S, "Theory of machines" 4th Edition, Tata McGraw Hill publishing Co., New Delhi, 2014.
2. Rao J.S. and Dukkipati R.V. "Mechanism and Machine Theory" Second Edition,Wiley Eastern Limited, 1992.
3. Bansal Dr.R.K. " Theory of Machines" Laxmi Publications (P) Ltd., New Delhi, 2015.

Other references:

1. Shingley J.E. and Vicker J.J. Theory of Machines and Mechanisms" McGraw Hill, 1986.
2. Malhotra D.R. and Gupta H.C "The Theory of machines" Satya Prakasam, Tech. India Publications, 1989.

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U15AU*T*403 AUTOMOTIVE ENGINES

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Construction and operation of IC Engine

CO2: Understand the Fuels and Combustion in IC Engines

CO3: Apply the knowledge for Performance calculation of IC Engine

Pre-requisite:

1. Thermodynamics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		S		S	S						S	M	M
CO2	M		S	M								S	S	
CO3	S		S			S						S	S	M

Course Assessment methods:

Direct	Indirect
1. Assignments	1. Course Exit Survey
2. Continuous assessment tests	
3. End-semester examination	

ENGINE CONSTRUCTION AND OPERATION **10 Hours**

Four stroke SI and CI engines – Working principle – function, materials, constructional details of engine components – Valve timing diagram – Firing order and its significance – relative merits and demerits of SI and CI engines

Two stroke engine construction and operation. Comparison of four-stroke and two-stroke engine operation

FUELS AND COMBUSTION **10 Hours**

Combustion equation, conversion of gravimetric to volumetric analysis – Determination of theoretical minimum quantity of air for complete combustion – Determination of air fuel ratio for a given fuel.

Properties and rating of fuels (petrol and diesel), chemical energy of fuels, reaction equation, combustion temperature, combustion chart.

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COMBUSTION IN SI ENGINES **8 Hours**

Combustion in premixed and diffusion flames – Combustion process in IC engines. Stages of combustion – Flame propagation – Flame velocity and area of flame front – Rate of pressure rise – Cycle to cycle variation – Abnormal combustion – Theories of detonation – Effect of engine operating variables on combustion. Combustion chambers – types, factors controlling combustion chamber design.

COMBUSTION IN CI ENGINES **9 Hours**

Importance of air motion – Swirl, squish and turbulence – Swirl ratio. Fuel air mixing – Stages of combustion – Delay period – Factors affecting delay period, Knock in CI engines – methods of controlling diesel knock. CI engine combustion chambers – Combustion chamber design objectives – open and divided. Induction swirl, turbulent combustion chambers. – Air cell chamber – M Combustion chamber

ENGINE PERFORMANCE **8 Hours**

Performance parameters – BP, FP, IP, Torque specific fuel consumption, Specific Energy consumption, volumetric efficiency, thermal efficiency, mechanical efficiency, Engine specific weight, and heat balance. Testing of engines – different methods. Numerical problems

Theory :45 Hrs **Total Hours: 45**

References:

1. Ganesan V, “Internal combustion engines”, 4th edition, Tata McGraw Hill Education, 2012.
2. Rajput R. K, “A textbook of Internal Combustion Engines”, 2nd edition, Laxmi Publications (P) Ltd, 2007.
3. John. B, Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Publishing Co., New York, 1990 .
4. Ramalingam K. K, “Internal Combustion Engines”, Second Edition, Scitech Publications.
5. Sharma S. P, Chandramohan, “Fuels and Combustion”, Tata McGraw Hill Publishing Co, 1987.
6. Mathur and Sharma, “A course on Internal combustion Engines”, Dhanpat Rai & Sons, 1998.

Other references:

1. Edward F, Obert, “Internal Combustion Engines and Air Pollution”, Intext Education Publishers.
2. Ellinger, H.E., Automotive Engines, Prentice Hall Publishers, 1992.

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U15AUT404 MODELING AND SIMULATION OF AUTOMOTIVE SYSTEMS

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the need for mathematical modelling, time and frequency response when subjected to a disturbance.

CO2: Attempt modelling real life systems of interest in order to predict its dynamic behavior

CO3: Use simulation tools to determine dynamic response of system following external inputs

CO4: Apply a controller to a specific application and tune it accordingly to get the desired response.

CO5: Take up advanced courses on system dynamics, monitoring and control with familiarity on terminology and techniques employed in the above

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S						S							
CO2	M					W								S
CO3		M			S									
CO4	S		S	S							M	W		M

Course Assessment methods:

Direct	Indirect
1. Assignments	1. Course Exit Survey
2. Presentations	
3. End-semester examinations	

MODELING ELEMENTARY SYSTEMS 9+6 Hours

System, control system, Modeling – Linearity and Superposition – Lumped system dynamic behavior represented by ordinary differential equations –Modeling Translational and rotational mechanical Systems, Electrical systems, Electrical Analogous for Mechanical Systems, hydraulic systems and thermal systems.

MATHEMATICAL MODELING OF ELEMENTARY SYSTEMS USING MATLAB 9+6 Hours

Introduction to MATLAB, elementary Math built-in Functions, general Commands, Programming in MATLAB, dynamic response of general (including non – linear) system models through numerical integration of ODEs using MATLAB, Simulink.

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Simulation Tutorial: Mathematical modelling of elementary systems. Case study: Elementary suspension system

TIME RESPONSE ANALYSIS OF SYSTEMS 9+6 Hours

Time response, test signals, obtaining dynamic response of first order and second order linear systems for step inputs through analytical solution of governing equations – Transient response specifications – Delay time, rise time, peak overshoot, undamped natural frequency, damping factor, settling time

Simulation Tutorial: Determination of above parameters for an automotive system using simulink.

FREQUENCY RESPONSE OF ANALYSIS OF SYSTEMS 9+6 Hours

Frequency response, frequency domain specifications, Excitation and response signals of systems – Transfer functions – The sinusoidal steady state – Magnitude and phase response – Bode plots from transfer functions, Contributions from first order poles and zeros and complex conjugate pole pairs in frequency response.

AUTOMOTIVE CONTROL SYSTEMS 9+6 Hours

Different types of controllers - tuning of PID controller, application of PID controller to simple automotive systems.

Simulation Tutorial: PID control applications using Simulink

Note: The Simulation tutorial given in the syllabus is not for the End semester Exam

Theory :45 Hrs **Tutorial: 30 Hrs** **Total Hours: 75**

References:

1. P.D. Cha, J.J. Rosenberg & C.L. Dym, `Fundamentals of Modeling and Analyzing Engineering Systems', Cambridge University Press, 2000
2. Y. Jaluria, `Design and Optimization of Thermal Systems', Mc Graw Hill, 1998
3. Rao V.Dukkipati, 'MATLAB – An introduction with applications', New age international publishers, 2010.

Other references:

1. Nagrath I J and Gopal M, "Control Systems Engineering", Prentice Hall of India, New Delhi, 2002.

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U15EST003	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

At the end of this course the student is expected to

- understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources,
- what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity
- identify the major challenges in environmental issues and evaluate possible solutions.

Course Outcomes

After successful completion of the course, the student would be able to

CO1	Analyze the impact of engineering solutions in a global and societal context	**K4**
CO2	Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems	**K3**
CO3	Highlight the importance of ecosystem and biodiversity	**K2**
CO4	Ability to consider issues of environment and sustainable development in his personal and professional undertakings	**K3**
CO5	Paraphrase the importance of conservation of resources.	**K2**
CO6	Play a important role in transferring a healthy environment for future generations	**K3**

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M					S		M					
CO2						M				M				
CO3							M							
CO4						M	S							
CO5							S							
CO6			W				S					M		

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Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignment 3.Group presentation 4. End semester exam	Course end survey

Continuous assessment method

CO	Int 1	Int 2	End sem	Assignment	Presentation
CO1 - 20	50		20	20	20
CO2 - 15		40	15	15	15
CO3 -15	40		15	15	15
CO4 -20		50	20	20	20
CO5 -15	10		15	15	15
CO6 -15		10	15	15	15

Course Content

OBJECTIVES

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity.

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INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

14 Hours

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams benefits and problems - Water conservation, rain water harvesting, watershed management

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies

Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources

ECOSYSTEMS AND BIODIVERSITY **9 Hours**

ECOSYSTEM : Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids - Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

BIODIVERSITY : Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

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ENVIRONMENTAL POLLUTION **10 Hours**

Definition – Causes, effects and control measures of: (a) Air pollution - Organic and inorganic pollution - cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards - Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries - waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT **7 Hours**

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Human Rights

HUMAN POPULATION AND THE ENVIRONMENT **5 Hours**

Population growth and explosion – Welfare Programme - Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Theory : 45 Hours	**Total:45Hours**

REFERENCES:

1. Miller T.G, “Environmental Science”, Wadsworth Publishing Co, 2013.
2. Masters G.M., and Ela W.P., “Introduction to Environmental Engineering and Science”, Pearson Education Pvt., Ltd.
3. Bharucha Erach, “The Biodiversity of India”, Mapin Publishing Pvt. Ltd., Ahmedabad India, 2002.
4. Trivedi R.K and Goel P.K., “Introduction to Air pollution”. Techno-science Publications. 2003.

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5. Trivedi R.K., “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards”, Enviro Media, 1996.
6. Cunningham, W.P., Cooper, T.H.., & Gorhani E., “Environmental Encyclopedia”, Jaico Publication House, Mumbai, 2001
7. Wager K.D., “Environmental Management”, W.B. Saunders Co., USA, 1998
8. Townsend C., Harper J and Michael Begon, “Essentials of Ecology”, Blackwell science Publishing Co., 2003
9. Syed Shabudeen, P.S. “Environmental chemistry”, Inder Publishers, Coimbatore,2013

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U15AU*P*401

A) STRENGTH OF MATERIAL LABORATORY
B) FLUID MECHANICS & MACHINERY LABORATORY

L	T	P	C
0	0	2	1

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Required knowledge in the area of testing of materials and components of structural elements experimentally.

CO2: Use the measurement equipments for flow measurement

CO3: Do performance test on different fluid machinery

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	M	W	W				S		S		M	
CO2		S			S	W			M	M			M	M
CO3		S			S	W			M	M			M	M

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment	1. Course Exit Survey
2. Model Practical Examinations	
3. End Semester Practical Examinations	

A) STRENGTH OF MATERIAL LABORATORY

LIST OF EXPERIMENTS

1. Tension & Shear Test on Mild Steel Rod
2. a) Torsion Test on Mild Steel Rod
   b) Compression Test on Concrete Cube.
3. Hardness Test- Brinell, Vickers and Rockwell Hardness tests
4. Impact Test- Izod, Charpy Impact Tests
5. Test on Helical Springs- Compression and Tension Springs
6. Deflection Test on Beams

B)FLUID MECHANICS & MACHINERY LABORATORY

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of a given Orifice meter.
2. Determination of the Coefficient of discharge of a given Venturi meter.
3. Determination of friction factor for a given set of pipes.
4. Performance Characteristic curves of centrifugal pump
5. Performance characteristics of Francis turbine

(Note:Experiments beyond the syllabus should be conducted)

Total Hours 60

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U15AU*P*402 **A)FUELS AND LUBRICANTS LABORATORY**
B)ENGINE PERFORMANCE TESTING LABORATORY

L	T	P	C
0	0	2	1

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Test the performance of various engines using dynamometers.

CO2: Asses the performance characteristics of automotive engines

CO3: Measure the properties of fuels and lubricants

CO4: Measure the emission levels from vehicles and compare with Standards

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S		M				S			M	
CO2	S	S	S	S		M				S			M	
CO3	S	S	S	S		S	M						M	
CO4	S	S	S	S		S	M						M	

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment	1. Course Exit Survey
2. Model Practical Examinations	
3. End Semester Practical Examinations	

A)FUELS AND LUBRICANTS LABORATORY

LIST OF EXPERIMENTS

1. Distillation of fuels
2. Aniline Point test of diesel
3. Calorific value of liquid fuel & gaseous fuel.
4. Reid vapour pressure test and Corrosion Test
5. Flash and Fire points of fuels.
6. Cloud & Pour point Test.
7. Ash content and Carbon Residue Test
8. Viscosity of fuels & Lubricants
9. Drop point of grease and mechanical penetration in grease.

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B) ENGINE PERFORMANCE TESTING LABORATORY

LIST OF EXPERIMENTS

1. Performance study of petrol engine at full throttle and part throttle conditions.
2. Performance study of diesel engine both at full load and part load conditions.
3. Morse test on petrol engines.
4. Determination of compression ratio, volumetric efficiency and optimum cooling water flow rate in IC engines.
5. Heat balance test on an automotive diesel and petrol engine.
6. Engine tuning for performance improvement.
7. Study of NDIR Gas Analyser and FID.
8. Study of Chemiluminescent NOx analyzer
9. Measurement of HC, CO, CO_2, O_2 using exhaust gas analyzer
10. Diesel smoke measurement

(Note:Experiments beyond the syllabus should be conducted)

Total Hours 30

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U15EN*P*401 **COMMUNICATION SKILLS LABORATORY**

L	T	P	C
0	0	3	1

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Imparting the role of communicative ability as one of the soft skills needed for placement

CO2: Developing communicative ability and soft skills needed for placement

CO3: Making students Industry-Ready through inculcating team-playing capacity

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				M							M			M
CO2				W						M	S			M
CO3				S						W	S			M

Course Assessment methods:

Direct	Indirect
1. Continuous assessment method	1. Course Exit Survey
2. Presentation/Role Play/GD	
3. Interview	

GRAMMAR IN COMMUNICATION **9 Hours**

Grammar and Usage – Building Blocks, Homonyms, Subject and Verb Agreement, Error Correction - Grammar Application, Framing Questions – Question words, Verbal Questions, Tags, Giving Replies –Types of Sentences, Listening Comprehension –Listening and Ear training.

ASSERTIVE COMMUNICATION **9 Hours**

Listening Comprehension in Cross–Cultural Ambience, Telephonic Conversations/Etiquette, Role Play Activities, Dramatizing Situations- Extempore – Idioms and Phrases.

CORPORATE COMMUNICATION **9 Hours**

Video Sensitizing, Communicative Courtesy – Interactions – Situational Conversations, Time Management, Stress Management Techniques, Verbal Reasoning, Current Affairs – E Mail Communication / Etiquette.

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PUBLIC SPEAKING **9 Hours**

Giving Seminars and Presentations, Nuances of Addressing a Gathering - one to one/ one to a few/ one to many, Communication Process, Visual Aids & their Preparation, Accent Neutralization, Analyzing the Audience, Nonverbal Communication.

INTERVIEW & GD TECHNIQUES **9 Hours**

Importance of Body Language –Gestures & Postures and Proxemics, Extempore, Facing the Interview Panel, Interview FAQs, Psychometric Tests and Stress Interviews, Introduction to GD, Mock GD Practices.

Total Hours 45

References:

1. Bhatnagar R.P. & Rahul Bhargava, "English for Competitive Examinations", Macmillian Publishers, India, 1989, ISBN: 9780333925591
2. Devadoss K. & Malathy P., "Career Skills for Engineers", National Book Publishers, Chennai, 2013.
3. Aggarwal R.S., "A Modern Approach to Verbal & Non–Verbal Reasoning", S.Chand Publishers, India, 2012, ISBN : 8121905516

Other references(CD's)

1. Train2sucess series 1.Telephone Skills.2. Interviewing Skills 3. Negotiation Skills by Zenith Global Consultants Ltd. Mumbai.
2. BEC Series.

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U15CS*P*203 **PROBLEM SOLVING TECHNIQUES**

L	T	P	C
1	0	2	2

Course Objectives:

To introduce students to the foundations of computing, programming and problem-solving.

To develop basic programming skills necessary for engineering education.

Course Outcomes (CO):

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

CO1	Write a pseudo code for the identified problem	S
CO2	Translate the pseudo code into an executable program	S
CO3	Validate the program for all the possible inputs.	S
CO4	Identify an appropriate approach to solve the problem	S
CO5	Use different data structures	S

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M		M					W					S
CO2	S	M		M	S				W					S
CO3	S	M		M					W					S
CO4	S	M		M					W					S
CO5	S	M		M					W					S

Course Assessment Methods:

Direct	Indirect
• Model Lab Exam • End Semester Practical Exam	• Course Exit Survey

Course Content:

Problem solving

General problem solving concepts, approaches and challenges, problem solving with computers, data structures

Approaches

Solve by analogy, Decompose the task into smaller subtasks, Building block approach, merging solutions, Algorithmic thinking, Choice of appropriate data structures, Implementation of the Pseudo-code, implementing the code, testing the solution

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Introduction to program structure

Variables and constants, local and global variables, expressions, control structures, selection structures, arithmetic, relational and logical operators, Conditional and looping statements, programming in manageable pieces: program modules, subprograms, functions and recursion

Problem to code approach

Problem statement, problem analysis, program design, program code, program test

Sorting (Numbers and Strings)

Bubble sort, Insertion sort, Selection Sort

Searching (Numbers and Strings)

Binary search, Random search, Search for Max-Min

References:

1. *R. J. Dromey, How to solve it by Computer, Prentice Hall International, New Jersey, 2007*
2. *Harold Abelson and Gerald Sussman, Structure and Interpretation of Computer Programs, MIT Press, 1996.*
3. *Subhasis Banerjee, S. Arun Kumar, D. Dubhashi, Introduction to Computer Science, McGraw Hill India.*

List of Experiments:

I **Problems based on Numbers:**

1) Write a program to compute the factorial of a given number.

Test Case	**1**	**2**	**3**	**4**
Input	8	1	0	-5
Output	40320	1	1	Invalid

2) Write a program to find all numbers between 2000 and 3000 (both inclusive) which are divisible by 7 but not a multiple of 5. All such numbers are to be printed in a comma separated sequence on a single line.
Output: 2002, 2009, 2016, … 3199

II **Problems based on Data Processing:**

1) Write a program that takes an IP address of the form P.Q.R.S as input, where P, Q, R and S are decimal numbers in the range 0 to 255, and prints the class of the address as indicated in the table below.

Value of P	**Class**
1 – 126	A
128 – 191	B
192 – 223	C
224 – 239	D
240 – 254	E

Test Case	**1**	**2**	**3**	**4**	**5**
Input	224.220.206.91	126.220.206.91	127.0.0.1	0.100.100.100	255.255.255.255
Output	Class D	Class A	Invalid	Invalid	Invalid

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2) Write a program to check if a given number is a stepping number or not.
Note: A number is called a stepping number if every adjacent digit, except those separated by commas, differs by 1. A stepping number can't be a 1-digit number; it must be at least a 2-digit number. For example 45 and 43,545 are valid stepping numbers, but 890,098 is not a stepping number because the difference between numbers 9 and 0 cannot be considered as 1.

Test Case	1	2	3	4	5
Input	567	89,432	780,023	7	49
Output	Valid	Valid	Invalid	Invalid	Invalid

3) Write a program that takes a large English text file as input and counts the number of occurrences of each alphabet in the text.
(i) Display the alphabet with maximum and minimum number of occurrences.
(ii) Swap the alphabets with maximum and minimum occurrences to obtain a modified text file.
(iii) Take the output of (ii) as input and get back the original text file.

Test case:
Input: A text file with 3000 characters - in which 500 are e and 5 are z.
Output: (i) Maximum occurrence – e and Minimum occurrence – z
(ii) The characters e and z in the text file are swapped to get a modified text
(iii) The original text file

4) The property of Exclusive OR operation (i) Any X $\oplus$ X is 0 (ii) Any X $\oplus$ 0 is X.
An Encryption and Decryption scheme using this property is given below:
Encryption Algorithm: Cipher Text (C) = Plain Text (P) $\oplus$ Key (K)
Decryption Algorithm: Plaint Text (P) = Cipher Text (C) $\oplus$ Key (K)
Answer the following questions:
(i) For any given P and the corresponding C, find K [K = P $\oplus$ C]
(ii) For any given C and the corresponding key K, find P [P = C $\oplus$ K]

Test Case		1	2	3
Input	P	1 1 0 0 1 1 0 0	0 0 1 1 1 1 0 0	1 1 1 1 1 1 1 1
	C	0 0 1 1 0 0 1 1	1 0 1 0 1 0 1 1	1 1 1 1 1 1 1 1
Output	Key	1 1 1 1 1 1 1 1	1 0 0 1 0 1 1 1	0 0 0 0 0 0 0 0
	New cipher text	0 0 0 0 0 0 0 0	1 1 0 0 1 1 1 1	11 11 1 1 1 1
	Plaintext (New cipher text $\oplus$Key)	1 1 1 1 1 1 1	0 1 0 1 1 0 0 0	1 1 1 1 1 1 1 1

5) Write a function num_atoms( ) that takes the weight of the element in grams and its atomic weight as parameters and calculates the number of atoms in n grams of an element.
Note: Atomic weight of gold (Au) 196.97 with units in grams/mole.
Atomic weight of carbon=12.001, Atomic weight of hydrogen=1.008
Avogadro's number is a constant, 6.022×10^{23}
Test Case 1:
Amount of gold =4.5grams, n = 0.45/197 = 2.28×10^{-3} , 1 mol = 6.022×10^{23} atoms
Total number of atoms =$6.022 \times 10^{23} \times 2.28 \times 10^{-3} = 13.756 \times 10^{20}$

6) Define a procedure histogram() that takes a list of integers and prints a histogram to the screen.

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Test Case	1	2	3
Input	histogram([4])	histogram([-3, 6, 12])	histogram([2, 0, 3])
Output	****	****** **********	** ***

7) Write a program to solve this classic ancient Chinese puzzle: We count 35 heads and 94 legs among the chickens and rabbits in a farm. How many rabbits and how many chickens do we have?

8) In cryptography, a Caesar Cipher is a very simple encryption technique in which each letter in the plain text is replaced by a letter some fixed number of positions down the alphabet. For example, with a shift of 3, A would be replaced by D, B would become E, and so on. ROT-13 ("rotate by 13 places") is a widely used example of a Caesar cipher where the shift is 13. Write a program to implement an encoder/decoder of ROT-13.

Test Case	1	2
Input	Roy eats	Deer stays back
Output	Ebl rngf	Qrre fgnlf onpx

9) Newton's Second Law of motion is expressed as $F = m \times a$, where F is force, m is mass and a is acceleration. Write a program to calculate the acceleration if mass of an object and the force on that object are given as input. Display the result to the user.

Test Case	1	2
Input	Mass=5, Force =1050	Mass =3, Force=564
Output	210	188

III **Problems based on Strings and Functions:**

1) Write a program (using functions) that takes a long sentence with multiple words as input and rearranges the words in the sentence in the reverse order.

Test Case	1	2	3
Input	My name is python	Kumaraguru College of Technology	Problem based on Strings
Output	python is name My	Technology of College Kumaraguru	Strings on based Problem

2) Write a program that accepts a sequence of 4 digit binary numbers as its input, which are comma separated and prints as output, only the binary numbers that are divisible by 5 in the same format.

Test Case	1	2	3
Input	0100,0011,1010,1001,1100, 1001,0101	0010, 1111, 1100	1110, 1000, 1110
Output	1010, 0101	1111	Not divisible by 5

3) Write a program that accepts a sentence as input and calculates the number of letters, digits and special characters.

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Test Case		1	2
Input sentence		hello world! @$ 123	There is a laptop with #CS123…
Output	Letters	10	20
	Digits	3	3
	Special Characters	3	4

4) Write a String tokenizer program that accepts a file as input and counts the number of lines and words and prints the same as output. (Note: You can use wc command also)

Test Case	Input Sentences	No. of lines	No. of words
1	Correctness and efficiency issues in programming, time and space measures Basics of imperative style programming Assertions and loop invariants	3	19
2	greedy algorithms are not always the optimal process, even after adjusting the order of their processing	2	16

5) Write a "space_correction()" function that takes a string (sentence) as input and examines it for space characters. If there are two or more continuous space characters in the sentence then they are deleted, so as to have only one space character between words. It also examines the end of sentences; if the period (full stop) is directly then followed by a letter it inserts a space after the period.

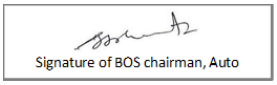
Test case I	Input	space_correction(“This is very funny and cool.Indeed!")
	Output	"This is very funny and cool. Indeed!"
Test case II	Input	space_correction(“A flow chart provides appropriate steps to be followed.it is a program design tool”)
	Output	A flow chart provides appropriate steps to be followed. it is a program design tool

6) Write a function printValue() that can accept two strings as input and prints the longer of the two. If two strings have the same length, then the function should print both the strings.

Test case	1	2	3
Input	printValue(“one”,”three”)	printValue(“laptop”,”laptop”)	printValue(“ten”,”so”)
Output	three	laptop laptop	ten

7) An anagram is a type of word play, the result of rearranging the letters of a word, using all the letters in the original word exactly once; e.g., uleb = blue. Write a program that accepts the jumbled characters from user and choose the correct word from the given list by rearranging the characters in the word. Display the word, if it is available in the given list of word. Assume that the list of words is set of colors like {brown, blue, green etc}

Test case	1	2	3
Input	onwbr	reegn	etihw
Output	brown	green	white



8) Assuming that we have some email address of the form "username@companyname.com". Write a program to print the user name of a given email address. Both user names and company names consists of letters only.

Test case	**1**	**2**
Input	inboxcse@gmail.com	csedeptgroups#yahoomail.com
Output	inboxcse	Invalid email address

9) Write a program that takes a string as input and prints the number of occurrences of each character in the string.

Test case	**1**	**2**
Input	abbaca	icici
No. of occurrences	a=3,b=2,c=1	i-3 , c-2

10) Write a recursive function and an iterative function to compute the Fibonacci sequence. Compare the performance of both functions.

11) Write a version of a palindrome recognizer that also accepts phrase palindromes such as "Go hang a salami I'm a lasagna hog.". (Note: punctuation, capitalization and spacing are ignored)

Test case	**1**	**2**
Input	i am tired	was it a rat i saw
Output	Not a palindrome	Palindrome

12) In English, a sentence using present continuous is formed by adding the suffix *-ing* to the verb.(example: go→ going).

A simple set of heuristic rules can be given as follows:

1. If the verb ends in *e*, drop the *e* and add *ing* (if not exception: be, see, knee, etc.)
2. If the verb ends in *ie*, change *ie* to *y* and add *ing*
3. For words consisting of consonant-vowel-consonant, double the final letter before adding *ing*
4. By default, just add *ing*

Write a function "make_ing_form()" which converts a given verb to present continuous form. Test your function with words such as lie, see, move and hug.

Test case	**1**	**2**	**3**	**4**
Input	believe	tie	sit	walk
Output	believing	tying	sitting	walking

13) A pangram is a sentence that contains all the letters of the English alphabet at least once. Write a function to check if a given sentence is a pangram or not. If the given sentence is not a pangram print the missing letters.

Test case	**1**	**2**
Input	*The quick brown fox jumps over the lazy dog*	*The quick brown rat jumps over the lazy cat*
Output	Pangram	Not a Pangram Missing letters*:f,x,d,g*

14) Write a function "calc_weight_ on_ planet()" that takes two arguments - weight on Earth and the surface gravity of the other planet and calculates the equivalent weight on the other planet. (Note: The surface gravity of Jupiter is 23.1 m/s^2 (approx) and that of Earth is 9.8 m/s^2(approx), Weight = Mass x Surface gravity)

Test case	**1**	**2**
Weight on Earth(lb)	*127.2*	*-100*

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Weight on Jupiter	297.6	*Invalid*

15) Write a program to check the validity of passwords entered by users.
Following are the criteria for a valid password:
1. At least 1 letter between [a-z]
2. At least 1 letter between [A-Z]
3. At least 1 number between [0-9]
4. At least 1 character from [$#@]
5. Minimum length of password: 6
6. Maximum length of password: 12

Your program should accept a sequence of passwords that are comma separated and check them for validity based on the criteria given above and print the valid passwords only in the comma separated form.

Test case	**1**	**2**	**3**
Input	ABd1234@1, a F1#,2w3E*,2We3345	HFd1244@1, a F1#,2w3E*,2We334#5	ABd12342, a F1#,2w2B*,2We3345
Output	ABd1234@1	HFd1244@1, 2We334#5	Invalid

V **Problems based on Data Structures:**

1) Write a program that maps a list of words to a list of integers (representing the lengths of the corresponding words). Write it in three different ways: 1) using a for-loop, 2) using the higher order function map (), and 3) using list comprehensions
2) Write a program that prompts the user to enter the name of the fruit and its weight. The program should then display the information in the same form but in the alphabetical order.

Test case	**1**	**2**	**3**
Input	Kiwi, 4 kg, Apple, 6 kg, Banana, 11 kg	Gowva, 4 kg, Apple, 6 kg, Banana, 11 kg	Carrot, 4 kg, Kiwi, 6 kg, Banana, 11 kg
Output	Apple, 6 kg, Banana, 11 kg, Kiwi, 4 kg	Apple, 6 kg, Banana, 11 kg, Gowva, 4 kg	Banana, 11 kg, Carrot, 4 kg, Kiwi, 6 kg

3) Write a program that prompts the user to enter a list of words and stores them in a list. Create a new list that retrieves words from the first list such that first letter occurs again within the word. The program should display the resulting list.

Test case	**1**	**2**
Input	Baboon, List, Duplicate	Frog, Snake, Lizard
Output	Baboon	No Such word exist in list

4) List Overlap Solution:
Consider the following lists, A = [1,1,2,3,5,8,13,21,34,55,89] &
B = [1,2,3,4,5,6,7,8,9,10,11,12,13]
Write a program that returns a list that contains only the elements that are common between the lists (without duplicates). Make sure your program works on two lists of different sizes.
Hint: (A intersection B)

Test cases:
Input the following lists,
A = [1,1,2,3,5,8,13,21,34,55,89] B = [1,2,3,4,5,6,7,8,9,10,11,12,13]

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Output: A ∩ B= [1,2,3,5,8,13]

VI **Problems based on Sorting:**

1) Write a program to sort the (name, age, score) tuples in ascending order where name is string, age and score are numbers. The tuples are input using the console. The sort criteria are:
   a. Sort based on name
   b. Then sort based on age;
   c. Then sort by score
   d.

Test case	**1**	**2**
Input	Tom,19,80 John,20,90 Jony,17,91	Jony,17,91 Jony,17,93 Json,21,85
Output	[('John', '20', '90'), ('Jony', '17', '91'), ('Jony', '17', '93'),('Tom', '19', '80')]	[('Jony', '17', '91'), ('Jony', '17', '93'), ('Json', '21', '85')]

2) Write a program that accepts a sequence of words that are hyphen separated as input and prints the words in a hyphen-separated sequence after sorting them alphabetically.

Test case	**1**	**2**	**3**
Input	green-red-yellow-black-white	red-yellow-black	green-yellow-white
Output	black-green-red-white-yellow	black -red-yellow	green-white-yellow

VII **Problems based on Divide and Conquer:**

1) Write a program for binary search using arrays

Test case	**1**	**2**
Input	4, 7,8,11,21	4, 7,8,11,21
Enter the number to be search	11	18
Output	The number is present	The number is not present

VIII **Problem Solving by Backtracking:**

1) Write a program to solve the 4-Queen's Problem.

Total Hours:24

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U15GH*P*401/ PROFESSIONAL VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	**1**	**0**	**0**	**1**

Objectives

1. To sensitize students about being professional
2. To sensitize about the importance of being ethical in one's profession
3. To understand various leadership theories
4. To understand the concept of karma yoga (Self less Work)
5. To be aware of the current strengths and weakness and how to develop on strengths

Course outcomes:

After successful completion of the course, the student would be able to:

1. The Students shall acquire knowledge on the Clarity, courage, confidence, commitment, compassion this required for a good professional
2. The Students shall understand the concept of Karma Yoga and lead his/her life accordingly
3. The Students shall understand the importance of ethics in ones profession and practice it
4. The Students shall get acquainted with leadership theories and use them in his/her profession appropriately
5. The Student shall learn how to be an empowered professional and how to empower colleagues

Pre-requisite: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M	W			W	M	M	M			M		
CO2		W				M	S	M	M			S		
CO3					M		S	S	W	W		M		
CO4		W				M	M	M	S	W		M		
CO5		W				M	M	W	M			M		

Course Assessment methods:

Direct	Indirect

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1.Individual Assignment 2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	1.Attendance and Behavioural Assessment

Introduction to Professional Values	1 Period
Concept of Integral Karma Yoga	3 Periods
Professional Ethics	3 Periods
Eastern and Western Leadership Theories	2 Periods
Empowerment of a Professional	4 Periods
Advanced Contemplative Practices with Demonstrations	2 Periods
	Total Periods: 15

References Books:

1. Rishabhchand, ***"Integral Yoga of Sri Aurobindo"*,** Sri Aurobindo Ashram Publication Department, Pondicherry, Published 2001.
2. Charles E Harris, **"*Engineering Ethics: Concepts and Cases*",** 4th edition, Western Michigan University, Published 2009.
3. Devdas Menon, **"*Spirituality at Work*",** professor of structural engineering at IIT Madras.
4. Ameeta Mehra, **"*Karma Yoga: Perfection in Work*",** The Gnostic Centre, New Delhi, Published 2000.
5. Winthrop Sargeant,"***The Bhagavad Gita"***, State University of New York, Published 1994.
6. D.R Kiran, ***"Professional Ethics& Human Values"***, The Mc Graw Hill/BSP Books, Published 2013.
7. S. Bhaskar, ***"Professional Ethics& Human Values"***, The Aunradha Agencies, Chennai, Published 2005.
8. Keith Ward & Cliff Bowman, ***"Extraordinary performance from ordinary people",*** Routledge, Published 2007.
9. Stephen Robbins, "Organization Behavior", The Prentice Hall; 15 editions, 2012.

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SEMESTER V

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U15AU*T*501 AUTOMOTIVE ENGINE SYSTEMS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Intake and Exhaust Systems

CO2: Understand the Carburetion and injection in Engines

CO3: Understand the Supercharging, Turbocharging and Scavenging in Engines

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W	W					M					M	M	S
CO2	W	W					M					M	M	S
CO3	W	W					M					M	M	S

Course Assessment methods:

Direct	Indirect
1. Assignments	1. Course Exit Survey
2. Continuous assessment tests	
3. End-semester examination	

INTAKE AND EXHAUST SYSTEMS 9 Hours

Intake system components – Discharge coefficient, Pressure drop – Air filter, intake manifold, Connecting Pipe – Exhaust system components – Exhaust manifold and exhaust pipe – Spark arresters – Exhaust mufflers, Types, operation

CARBURETION AND GASOLINE INJECTION 9 Hours

Mixture requirements for steady state and transient operation, Mixture formation studies of volatile fuels, design of elementary carburetor Chokes – Effects of altitude on carburetion – Carburetor for 2-stroke and 4-stroke engines – carburetor systems for emission control.

Petrol injection – Open loop and closed loop systems, mono point, multi-point and direct injection systems – Principles and Features, Bosch injection systems.

DIESEL INJECTION 9 Hours

Requirements – Air and solid injection – Function of components – Jerk and distributor type pumps-pump calibration .Pressure waves – Injection lag – Unit injector – Mechanical and pneumatic

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governors – Fuel injector – Types of injection nozzle – Nozzle tests – Spray characteristics – Injection timing – Factors influencing fuel spray atomization, penetration and dispersion of diesel – Overview of Diesel Injection advanced technologies

9 Hours

LUBRICATION AND COOLING

Need for cooling system – Types of cooling system – Liquid cooled system: Thermosyphon system, Forced circulation system, pressure cooling system – properties of coolant, additives for coolants
Need for lubrication system – Mist lubrication system, wet sump any dry sump lubrication – Properties of lubricants, consumption of oil.

SUPERCHARGING AND SCAVENGING **9 Hours**

Objectives – Effects on engine performance – engine modification required – Thermodynamics of supercharging and Turbocharging – Turbo lag-Windage losses- Turbo charging methods – Engine exhaust manifold arrangements.
Classification of scavenging systems –Mixture control through Reed valve induction – Charging Processes in two-stroke cycle engine – Terminologies – Shankey diagram – perfect displacement, perfect mixing

Theory :45 Hrs **Total Hours: 45**

References:

1. Ganesan V, “Internal combustion engines”, 4th edition, Tata McGraw Hill Education, 2012.
2. Rajput R. K, “A textbook of Internal Combustion Engines”, 2nd edition, Laxmi Publications (P) Ltd, 2007.
3. John. B, Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Publishing Co., New York, 1990 .
4. Ramalingam K. K, “Internal Combustion Engines”, Second Edition, Scitech Publications.

Other references:

1. Duffy Smith, “Auto Fuel Systems”, The Good Heart Willcox Company Inc.,
2. Publishers, 1987. Edward F, Obert, “Internal Combustion Engines and Air Pollution”, Intext Education Publishers.

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U15AU*T*502 MACHINE COMPONENT DESIGN

L	T	P	C
3	2	0	4

Course Outcomes(COs)

After successful completion of this course, the students should be able to:

CO1: Understand and Apply Engineering Design process

CO2: Apply engineering principles and analytical techniques in the design process

CO3 Design the Machine Components like Shafts and Springs Gear Design Flywheels and Bearings.

Pre-requisite:

1. Strength of Materials

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	M					M	S	W			
CO2	S	S	S	M					M	M	M			
CO3	S	S	S	M					M	W	S		S	

Course Assessment methods:

Direct	Indirect
1. Assignments	
2. Continuous assessment tests	
3. End-semester examination	

INTRODUCTION 9+6 Hours

Classification of design – Engineering materials and their physical properties as applied to design – Selection of materials – Factors of safety in design – Endurance limit of materials – Determination of endurance limit for ductile materials.

Limits-Types of fits – types of tolerance – calculation of minimum and maximum clearances and allowances.

DESIGN OF SHAFTS AND SPRINGS 9+6 Hours

Introduction – Material and design stresses – Design of axles – Design of shafts on the basis of strength – Design of shaft on the basis of rigidity – Design of hollow shafts – Design of close coiled helical spring subjected to axial loading – Torsion of helical springs.

GEAR DESIGN 9+6 Hours

Design considerations – strength of gear teeth – Lewis equation – Terminology of gears Dynamic tooth load – Design of spur gears – helical gears – bevel gears and worm gears.

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FLYWHEELS **9+6 Hours**

Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. Engine flywheels stresses of rim of flywheels. Design of hubs and arms of flywheel – Turning moment diagram.

DESIGN OF BEARINGS **9+6 Hours**

Design of journal bearings – Ball and Roller bearings – Types of Roller bearings – Bearing life – Static load capacity – Dynamic load capacity – Bearing material – Boundary lubrication – Oil flow and temperature rise.

Theory :45 Hrs **Tutorial: 30 Hrs** **Total Hours: 75**

References:

1. Jain,R.K., "Machine Design", Khanna Publishers, 1992.
2. Sundararaja Murthy, T.V., "Machine Design", Khanna Publishers, New Delhi, 1991.
3. Bhandari,v.B., "Design of Machine Elements", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.

Other references:

1. Hall Allen,S. & other, "Machine Design" , Schaum publisher Co., 1982.
2. Sigley, "Machine Design", McGraw Hill,1981.
3. "Design Data Book ", PSG College of Technology, Coimbatore,1992

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U15AU*T*503 **AUTOMOTIVE ELECTRICAL AND ELECTRONICS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Distinguish the various basic electrical and electronics systems of an automobile.

CO2: Select a battery, starter motor, lamps etc for a suitable application

CO3: Recognize and understand the different wiring diagrams used in automobile manuals.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S											M		S
CO2					M							M		S
CO3			M									W		M

Course Assessment methods:

Direct	Indirect
1. Assignments	1. Course Exit Survey
2. Presentations	
3. End-semester examinations	

TYPES OF BATTERIES **9 Hours**

Batteries – types, construction and working principle of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal Hydride Battery, Sodium Sulphur Battery and Aluminum air Battery, lithium ion batteries, Characteristics of batteries, battery rating, capacity and efficiency, Various Tests on battery, battery – charging techniques, maintenance of batteries.

STARTING AND CHARGING SYSTEM **9 Hours**

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators- construction and Characteristics, Voltage and Current Regulation, Cut –out relays and regulators, charging circuits

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IGNITION SYSTEM **9 Hours**

Components and working of Battery Coil and Magneto–Ignition System, Centrifugal and Vacuum Advance Mechanisms, Spark Plugs –construction, working and types, Electronic Ignition System, Distributor–less Ignition System, Digital Ignition System

FUEL INJECTION SYSTEM **9 Hours**

Introduction, electronic fuel carburetion, fuel injection- types and system overview, components of fuel injection system, diesel fuel injection – introduction of diesel fuel injection, diesel exhaust emissions, electronic control of diesel injection

WIRING, LIGHTING AND OTHER INSTRUMENTS **9 Hours**

Automotive electrical wiring, terminals and switching, multiplexed wiring system, electromagnetic compatibility(EMC), Lighting system – basic lighting system, Head Lamp and Indicator Lamps, Anti–Dazzling and Dipper system

Theory :45 Hrs **Total Hours: 45**

References:

1. Tom Denton, Automotive Electrical and Electronic Systems, Burlington, MA 01803, Elsevier Butterworth-Heinemann,2004
2. Young, A.P. and Griffith, S.L., Automobile Electrical Equipments, ELBS and New Press,1999
3. Kholi .P.L.Automotive Electrical Equipment, Tata McGraw-Hill co ltd, New Delhi,2004
4. Crouse.W.H. Automobile Electrical Equipment, McGraw Hill Book CoInc. NewYork, 2005.

Other references:

1. Judge.A.W.Modern Electrical Equipments of Automobiles, Chapman & Hall, London 2004 .
2. Robert Bosch, Automotive Handbook, Bently Publishers,2004

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U15AU*T*504 FINITE ELEMENT ANALYSIS

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Discretisation and finite element approach

CO2: Select appropriate elements to solve physical and engineering problems with emphasis as an automobile engineering applications

CO3: Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.

Pre-requisite:

1. Numerical Methods

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	W			W				M			M	S	M
CO2	S	W			W				M			M	S	M
CO3	S	W			W				M			M	S	M

Course Assessment methods:

Direct	Indirect
1. Internal Test	1. Course Exit Survey
2. Assignment/Presentation/Seminar	
3. Semester Exam	

8+6 Hours

INTRODUCTION

Historical background – Relevance of FEA to design problems, Application to the continuum – Discretisation – Matrix approach, Matrix algebra – Gaussian elimination – Governing equationsfor continuum – Classical Techniques in FEM – Weighted residual method – Ritz method,Galerkin method

ONE DIMENSIONAL PROBLEMS **12+6 Hours**

Finite element modeling – Coordinates and shape functions – Potential energy approach–Element matrices and vectors – Assembly for global equations – Boundary conditions – Higher order elements – Shapes functions – Applications to axial loadings of rods – Extension to plane trusses – Bending of beams – Finite element formulation of stiffness matrix and load vectors – Assembly to Global equations –boundary conditions – Solutions and Post processing – Automotive Examples.

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TWO DIMENSIONAL PROBLEMS – SCALAR VARIABLE PROBLEMS **6+6 Hours**

Finite element modeling – CST element – Element equations, Load vectors and boundary conditions – Assembly – Application to heat transfer – Automotive Examples.

TWO DIMENSIONAL PROBLEMS – VECTOR VARIABLE PROBLEMS **10+6 Hours**

Vector Variable problems – Elasticity equations – Plane Stress, Plane Strain and Axisymmetric problems – Formulation – element matrices – Assembly – boundary conditions and solutions Examples

ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL PROBLEMS **9+6 Hours**

Natural coordinates, Iso parametric elements, Four node quadrilateral element– Shape functions – Element stiffness matrix and force vector – Numerical integration – Stiffness integration – Displacement and Stress calculations – Examples.

Theory :45 Hrs **Tutorial: 30 Hrs** **Total Hours: 75**

References:

1. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education 2011, 4th Edition.
2. Logan D.L., "A First course in the Finite Element Method", Fifth Edition, Thomson Learning, 2012

Other references:

1. David V.Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2005. ISBN-0-07-239536-2

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U15AU*P*501 AUTOMOTIVE ELECTRICAL & ELECTRONICS LABORATORY

L	T	P	C
0	0	2	1

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Recognize and understand the different wiring diagrams used in automobile manuals.

CO2: Understand basic electrical and electronic circuits used in automobile systems and also understand the basic programming with the 8085 microprocessor

Pre-requisite:

1. Basics of Electrical and Electronics Engineering Laboratory

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			M											S
CO2	S				W							W		M

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment	1. Course Exit Survey
2. Model Practical Examinations	
3. End Semester Practical Examinations	

LIST OF EXPERIMENTS

AUTOMOTIVE ELECTRICAL LABORATORY

1. Testing of Batteries and Battery maintenance
2. Load Test on Starter motors and Alternators
3. Diagnosis of Ignition system
4. Power consumption of various automotive electrical systems
5. Head Light Adjustment & Intensity Test
6. Study of Automotive Electrical Wiring
7. Study of Power Window

AUTOMOTIVE ELECTRONICS LABORATORY

1. Study of rectifiers, Logic gates,555 timer
2. Study of RTD, LVDT, and Load Cell.
3. Study of A to D and D to A converters
4. Micro Processor programming and interfacing

(Note: Experiments beyond the syllabus should be conducted)

Total Hours: 30

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U15AU*P*502

AUTOMOTIVE COMPONENT ANALYSIS LABORATORY

L	T	P	C
0	0	2	1

Course Outcomes(COs)

After successful completion of this course, the students should be able to:

CO1: Analyze various 1D, 2D and 3D Structures using FEA tools.

CO2: Analyze heat transfer modes using FEA tools.

Pre-requisite:

1. Thermodynamics, and Strength of Materials

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	M	W	M	M	M			M		S	S	M
CO2	S	S	M	W	M	M	M			M		S	S	M

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment	
2. Model Practical Examinations	
3. End Semester Practical Examinations	

LIST OF EXPERIMENTS

1. Study of different commercial FEA tools used for design and analysis
2. Stress analysis of connecting rod
3. Stress analysis of crank shaft
4. Thermal analysis of cylinder liner
5. Stress analysis of leaf spring
6. Design and analysis of torsion bar
7. Temperature analysis of composite body panels
8. Design and analysis of piston crown

(Note: Experiments beyond the syllabus should be conducted)

Total Hours 45

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U15AU*P*503 TECHNICAL SEMINAR

L	T	P	C
0	0	2	1

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Recollect and appreciate the basics of automobile and mechanical engineering concepts by self-learning.

CO2: Prepare a presentation on the technical topic chosen in the proper format

CO3: Effectively communicate the contents to the target audience and handle questions with confidence

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S				W							M	M	M
CO2										S		M		
CO3										S				

Course Assessment methods:

Direct	Indirect
1. Technical presentation	1. Course Exit Survey
2. Report writing	

GUIDELINES:

1. The students would study and recollect the mechanical and automobile engineering fundamental theory subjects and the relevant application automotive product/technology by self learning through Curriculum Plus system.
2. The students would go through all the relevant chapters and answer the online quiz for the relevant chapters, which will be evaluated by the faculty coordinator as a continuous assessment.
3. The student will prepare a presentation individually on the topic from the relevant chapter chosen by him related to Automobile and approved by the faculty coordinator.
4. The contents of the presentation will include theory fundaments, applicable automotive products/technology, mathematics involved, experiments required for understanding the theory etc.
5. The student should be able to answer the questions asked by the audience during the presentation.

Total Hours 30

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U15GH*P*501/ SOCIAL VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	1	0	0	1

Objectives

1. To understand the genesis of society and social values
2. To understand the various sources of disparity among human beings
3. To empathize social issues and offer solutions wherever possible
4. To learn about social welfare organizations

Course outcomes:

After successful completion of the course, the student would be able to:

1. The students shall acquire knowledge about how societies are formed and social values are created
2. The students shall understand and empathize various social issues and contribute towards finding a solution
3. To understand the causes of disparity among human beings
4. To know about social welfare organizations and to use social media effectively
5. To understand various social parameters that influences individual and society at large

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		W				M	W	M	W			M		
CO2		W	W			W	M	M		W		M		
CO3		W				M	W	S				M		
CO4		W				S		M	W	M		S		
CO5			W		W	M	W			W		M		

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Course Assessment methods:

Direct	Indirect
1.Individual Assignment 2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	1.Attendance and Behavioural Assessment

Introduction to Social Values – Society	2 Periods
Development of Science, Education, Politics & Economics	3 Periods
Disparity among human beings	3 Periods
Social Issues & Welfare	3 Periods
Social Welfare Organizations	2 Periods

Yogasanas & Meditation
2 Periods

Total Periods: 15

References Books:

1. Swami Vivekananda, "***Prosperous India"*** 1st edition, The Ramakirshna Mission Institute of Culture, 1937.
2. Fritz Schumacher, ***"Small is Beautiful",*** The Blond & Briggs, Published 1973.
3. Vethathiri Maharishi***, "Logical Solutions for the Problems of Humanity",*** The World Community Service Centre, Vethathiri Publications, 1999.
4. Sarvepalli Radhakrishnan, ***"The Source Book on Indian Philosophy"***, Princeton, N.J. : Princeton University Press, 1957.
5. Sarvepalli Radhakrishnan, ***"Religion, Science and Culture",*** The Orient Paperbacks, India, Published 1994.
6. Vethathiri's Maharishi's, ***"Vethathirian Principles of Life"*** The World Community Service Centre, Vethathiri Publications, 2003.

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SEMESTER VI

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U15AU*T*601 **CHASSIS AND ENGINE COMPONENT DESIGN**

L	T	P	C
3	2	0	4

(Approved design data book is permitted for the end semester examination)

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Design of Vehicle Frame and Suspension
CO2: Design of Front Axle and Steering Systems
CO3: Design of Rear Axle and Braking System
CO4: Design of Cylinder and Piston
CO5: Design of Connecting Rod and Crankshaft
CO6: Design of Valves and Valve Train

Pre-requisite:

1. Strength of Materials-U15AUT505
2. Automotive Chassis- U15AUT301

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	M						M	M			S	M
CO2	S	S	M						M	M			S	M
CO3	S	S	M						M	M			S	M
CO4	S	S	M						M	M			S	M
CO5	S	S	M						M	M			S	M
CO6	S	S	M						M	M			S	M

Course Assessment methods:

Direct	Indirect
1. Assignments/Mini Projects	1. Course Exit Survey
2. Internal Test	
3. End semester Examination	

DESIGN OF CHASSIS COMPONENT

25+15 Hours

- Vehicle Frame and Suspension

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Study of Loads-Moments and Stresses on Frame Members. Design of Frame for Passenger and Commercial Vehicles.
Design of Leaf Springs-Coil Springs and Torsion Bar Springs.

- Front Axle and Steering Systems

Analysis of Loads-Moments and Stresses at different sections of Front Axle. Determination of Bearing Loads at Kingpin Bearings. Wheel Spindle Bearings. Choice of Bearings. Determination of Optimum Dimension and Proportions for Steering Linkages ensuring minimum error in Steering.

- Rear Axle

Design of propeller shaft. Design details of final drive gearing

- Braking System

Function, stopping time and distance, weight transfer during braking, brake actuating mechanisms – mechanical, hydraulic and pneumatic, disc and drum brakes - design of brake shoes and friction pads.

DESIGN OF ENGINE COMPONENT **20+15 Hours**

- Design of Cylinder and Piston

Choice of material for cylinder and piston, design assumptions and procedure for cylinder and piston. Design of cylinder, piston, piston pin, piston rings.

- Design of Connecting Rod

Design of Connecting Rod-determining minimum length of connecting rod, small end design, shank design, design of big end cap bolts

- Design of Crankshaft

Material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations, development of short and long crank arms. Front and rear-end details.

- Design of Valves and Valve Train

Design aspects of intake & exhaust manifolds, inlet & exhaust valves, valve springs, tappets and valve train.

Theory :45 Hrs **Tutorial: 30 Hrs** **Total Hours: 75**

References:

1. Dean Averns, "Automobile Chassis Design Book", 2nd edition, Kotelian sky Press, 2009.
2. Engine Design – Crouse, Tata McGraw Publication, Delhi
3. Julian Happian-Smith, "Introduction to Modern Vehicle Design", SAE International, 2004.
4. Giri, N.K., Automobile Mechanics, Khanna publishers, New Delhi, 2007.
5. Stokes. A, "*Manual Gearbox Design"*, Society of Automotive Engineers, 1992.
6. Khurmi. R.S. & Gupta. J.K., A textbook of Machine Design, Eurasia Publishing House (Pvt) Ltd, 2001.

Other references:

1. Heldt, P.M., Automotive Chassis, Chilton Book Co., 1992.
2. Dean Averns, Automobile Chassis Design, Illife Book Co., 2001.

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U15AU*T*602 VEHICLE DYNAMICS

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: To understand and the forces acting on the vehicle in static and dynamic condition
CO2: To understand the forces acting on tire and its influence on vehicle handling
CO3: To derive and infer the equations of a vehicle in static and dynamic
CO4: To understand the basics and isolation of vibration and sound in an automobile
CO5: To derive the equation of motion for various vibrating model

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	M												
CO3	S	S			M				M	S			S	
CO4	M	S												
CO5	S	S	M		M				M	S			S	
CO6														

Course Assessment methods:

Direct	Indirect
1. Internal Test	1. Course Exit Survey
2. Assignment/Presentation/Seminar	
3. Semester Exam	

INTRODUCTION **9+6 Hours**

Fundamentals of vibration, - Single, two, multi degrees of freedom systems - Derivation of equations of motion, influence coefficients, orthogonality principle, calculation of natural frequencies by Raleigh, Dunkerley, Holzer and matrix iteration methods, branched system, geared system. Modeling of an automobile for vibration study.

PERFORMANCE MODE **9+6 Hours**

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Acceleration - free body diagram of accelerating vehicle, maximum transferable tractive force, gradability, deceleration - maximum decelerating rates, stopping distance, maximum braking force, adhesion utilization - Straight line motion - aerodynamic forces and moments, viscosity effects - separation and its control - aerodynamic lift and its control - ground effect - profile for minimum drag.

RIDE MODE 9+6 Hours

Effects of damping the vibration, vibration absorbers, pitch and bounce motion, oscillation centers - active and semi active suspension - Orthogonality of mode shapes, modal analysis, vehicle performance testing.

HANDLING MODE 9+6 Hours

Tyres - mechanics, testing and modeling, vehicle control - low speed cornering and static steering - Ackerman steering geometry, steady-state cornering - steering factors, vehicle control parameters (under steer, neutral steer and over steer), steady state handling – lateral acceleration gain, characteristic speed, yaw velocity gain and critical speed - effect of braking on vehicle handling - constant radius testing - fish hook measurement testing.

VEHICLE STABILITY AND NOISE 9+6 Hours

Load distribution. Calculation of Tractive effort and reactions for different drives - Stability of a vehicle on a slope, on a curve and a banked road.

Properties of sound – sound level designation and measurements techniques - Sound isolation and absorption - machine enclosures, silencers and mufflers.

Theory :45 Hrs **Tutorial: 30 Hrs** **Total Hours: 75**

References:

1. Gillespie T.D, “Fundamentals of Vehicle Dynamics”, SAE USA 1992.
2. Rao J.S and Gupta. K “Theory and Practice of Mechanical Vibrations”, Wiley Eastern Ltd., 2002.
3. Giri N.K – Automotive Mechanics, Khanna Publishers, 2007.
4. Karl Popp, Werner O. Schiehlen, “Ground Vehicle Dynamics”, Springer, 2010.

Other references:

1. Rajesh Rajamani, “Vehicle Dynamics and Control”, Springer, 2012.
2. Georg Rill, “Road Vehicle Dynamics: Fundamentals and Modeling”, CRC Press, 2012.
3. Giles.J.G.Steering - “Suspension and Tyres”, Illiffe Books Ltd., London- 1998
4. Ellis. J.R, “Vehicle Dynamics”, Business Books Ltd., London, 1991.

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U15AU*T*603 **AUTOMOTIVE SENSORS AND EMBEDDED SYSTEMS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Apply the knowledge of engineering for the selection of sensors for measuring various parameters in automotive systems.

CO2: Apply the knowledge of sensors in the management of the vehicle control.

CO3: Program and interface various sensors used in automobiles using microcontrollers.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S											W		S
CO2			S			M					W			S
CO3			S								M			S

Course Assessment methods:

Direct	Indirect
1. Continuous assessment tests	1. Course Exit Survey
2. Quiz	
3. Lab Experiments	
4. End semester Examinations	

SENSORS **8 Hours**

Introduction to automotive sensors – resistive, inductive, capacitive transducers, Piezo electric transducers, Hall effect sensors, Ultrasonic sensors, Ranging radar (ACC)

Power Train:- Fuel level sensors, Speed and RPM sensors, Lambda Oxygen sensor, NOX sensors, Hotwire air mass meter **Chassis:-** Steering wheel angle sensor, Vibration and acceleration sensors, Pressure sensors, Speed and RPM sensors, torque sensors

ACTUATORS **8 Hours**

Introduction to automotive Actuators – Solenoids, Operation and application of brushless DC motors, Servo and stepper motors, switched reluctance motors, Suspension semi active actuators, Mangetostrictive anti vibration actuators, Piezo Actuators.

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INTRODUCTION TO EMBEDDED SYSTEM **10 Hours**

Introduction to embedded system, , applications of embedded system, Microcontroller v/s microprocessor, basic programs, introduction to PIC Microcontroller, Types and products of PIC - architecture - memory devices- addressing modes, memory mapping, System Peripherals and User peripherals – ADC

INTERRUPTS AND TIMERS **10 Hours**

Programming interrupts, counters and timers and serial communication(MSSP), CCP(Capture Compare PWM gen module)

INTERFACING WITH PIC **9 Hours**

Interfacing with LCD, sensors and motor control applications, Interfacing temperature sensor with PIC micro via ADC

Theory :45 Hrs **Total Hours: 45**

References:

1. Automotive Sensors, BOSCH. 2002
2. Ronald K. Jurgen, “Sensors and Transducers, 2nd Edition, SAE, 2003.

Other references:

1. Muhammad Ali Mazidi, Rolin McKinlay, Danny Causey, "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18" Pearson Education, 2007.

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U15AUT604 AUTOMOTIVE TRANSMISSION

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the purpose of clutch, gear box and drive train
CO2: Compare various types of transmission system
CO3: Understand the various types of drives

Pre-requisite:

1. Automotive Chassis

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M													
CO2	M								M	M		W		W
CO3	W			W										

Course Assessment methods:

Direct	Indirect
1. Internal Test	1. Course Exit Survey
2. Assignment/Presentation/Seminar	
3. Semester Exam	

CLUTCH AND GEAR BOX **9 Hours**

Problems on performance of automobile - such as resistance to motion, tractive effort, engine speed, engine power and acceleration. Requirement of transmission system. Different types of clutches, principle, Construction and torque capacity. Determination of gear ratios for vehicles. Different types of gearboxes such as Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox.

HYDRODYNAMIC DRIVE **9 Hours**

Fluid coupling - Principle of operation, Constructional details, Torque capacity, Performance characteristics and Reduction of drag torque. Hydrodynamic Torque converter - Principle of operation, Constructional details and Performance characteristics. Multistage torque converters. Polyphase torque converters. Converter coupling

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PLANETARY GEARBOXES **9 Hours**

Construction and operation of Ford – T-model gearbox, Wilson Gear box and Cotal electromagnetic transmission.

9 Hours

AUTOMATIC TRANSMISSION APPLICATIONS

Need for automatic transmission, Principle of operation. Hydraulic control system for automatic transmission. Chevrolet "Turboglide" Transmission, Continuously Variable Transmission (CVT) – Types – Operations.

HYDROSTATIC AND ELECTRIC DRIVE **9 Hours**

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. Electric drive - Principle of operation of Early and Modified Ward Leonard Control system, Advantages & limitations.

Theory :45 Hrs **Total Hours: 45**

References:

1. Heldt P.M – "Torque Converters"- Chilton Book Co.-1992
2. Judge, A.W., Modern Transmission systems, Chapman and Hall Ltd., 1990.
3. Newton and Steeds – "Motor Vehicle"- Illiffee Publisher- 2000.
4. Design Practices, passenger Car Automotive Transmissions- SAE Hand book-1994.

Other references:

1. Crouse, W.H., Anglin, D.L., Automotive Transmission and Power Trains construction, McGraw Hill, 1992.
2. Heldt, P.M., Torque converters, Chilton Book Co., 1992.

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U15AU*P*601 VEHICLE DYNAMICS LABORATORY

L	T	P	C
0	0	2	1

Course Outcomes(COs)

After successful completion of this course, the students should be able to:

CO1: Analyze the Dynamic modeling and simulations of road vehicles and their subsystems.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W	W	W	S				M	M	W	M	S	

Course Assessment methods:

Direct	Indirect
1. Problem solving	
2. Practical Classes	
3. Semester Lab Examinations	

LIST OF EXPERIMENTS:

1. Study on automotive systems simulation
2. Simulation and analysis of Rigid Axle Suspension system
3. Simulation and analysis of Independent Suspension system
4. Simulation and analysis of hydraulic brake system
5. Simulation and analysis of air brake system
6. Simulation of steady state cornering characteristics of vehicle
7. Modeling of tires and analysis of cornering characteristics
8. Roll stability and Rollover threshold analysis
9. Simulation of a half car model for pitch and bounce
10. Crash Test Simulation Analysis of a four wheeler.

(Note:Experiments beyond the syllabus should be conducted)

Total Hours 30

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U15AU*P*602 **ADVANCED AUTOMOTIVE SYSTEMS LABORATORY**

L	T	P	C
0	0	2	1

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Apply the knowledge of sensors in the management of the vehicle control.

CO2: Interface and simulate various sensors used in automotive systems to different software's.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M			M										S
CO2				M	S						S			S

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment	1. Course Exit Survey
2. Model Practical Examinations	
3. End Semester Practical Examinations	

LIST OF EXPERIMENTS:

1. RPM Measurement Using
   - (i) Hall effect Sensor
   - (ii) Inductive Type Sensor
2. Brake Pedal Position measurement
   - (i) using Hall Eeffect sensor
   - (ii) Designing of P, PI, PID controllers using performance criteria
3. Labview Programming :
   - (i) Temperature Conversion
   - (ii) Debugging and Sub-VI creation
   - (iii) Loops and Waveform Charts
   - (iv) Case statements, Arrays and Clusters
   - (v) Strings and File Input/output

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4. Data Acquisition Systems using Lab view
    - (i) Strain measurement system
    - (ii) Temperature measurement system
    - (iii) Pressure measurement system
5. Modeling and simulation of Automotive sub systems
    - (i) mathematical modeling of elementary systems
    - (ii) Engine Model,
    - (iii) Anti-Lock Braking System,
    - (iv) Suspension System,
    - (v) Hydraulic System

(Note:Experiments beyond the syllabus should be conducted)

Total Hours 30

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U15AU*P*603 MINI PROJECT

L	T	P	C
0	0	2	1

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Identify an innovative or creative idea/concept/solution to a problem

CO2: Demonstrate their report writing and presentation skills

Pre-requisite:

1. Design and Manufacturing

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	S					S	S	M
CO2										S	S			

Course Assessment methods:

Direct	Indirect
1. Project reviews - 40%	1. Course Exit Survey
2. Project Report - 10 %	
3. Viva-voce - 50%	

GUIDELINES:

1. The Mini Project-2 will essentially contain a detailed design and fabrication of a model or a prototype of a mechanism or a subsystem of automotive system.
2. The project work may include literature review, modeling, analysis, simulation, fabrication, testing and analysis of test data etc.
3. Can be individual or a group project, with maximum of 3 students per group.
4. The progress of the project is evaluated based on a minimum of three reviews and final viva-voce examination.
5. A project report is required to be submitted at the end of the semester in the required format.
6. The review presentations and project report should contain the individual work allocation & contribution, estimated & actual time schedule with charts (PERT/GANTT), FMEA/DFMEA charts, prototype cost estimations, drawings, 3D models, manufacturing process charts, in addition to the details of project work carried out.

Total Hours 60

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U15GH*P*601/ NATIONAL VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	**1**	**0**	**0**	**1**

Objectives

1. To enlighten students about responsible citizenship and polity
2. To sensitize the greatness of India and Indian Culture and to encourage students to uphold them
3. To be aware of the India's messages to world and propagate them as when possible
4. To understand about the uniqueness of India
5. To know about famous Indian personalities and their characteristics and to know about their contributions

Course outcomes:

After successful completion of the course, the student would be able to:

1. The Students shall acquire knowledge on the Enlightened Citizenship.
2. The Students shall know skills the greatness of India and Indian Culture.
3. The students shall be aware of the messages of India to the world
4. The Students shall be aware of the uniqueness of India
5. The students shall know about the inspiring Indian personalities and emulate them

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		W				M		M				M		
CO2		W				S	W	S	M	M		M		
CO3		W	W		W	M	W	M	M	M		M		
CO4		W				M	W	M	W	W		M		
CO5						W	M	W	W	W		S		

Course Assessment methods:

Direct	Indirect

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1.Individual Assignment 2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	1.Attendance and Behavioural Assessment

Enlightened Citizenship	2 Periods
Greatness of India & Indian Culture	2 Periods
Uniqueness of India	2 Periods
Famous Indian Personalities	2 Periods
India's messages to the world	3 Periods
Meditation & Yogasanas	4 Periods

Total Periods: 15

References Books:

1. Gurcharan Das, "***India Grows at Night***", Penguin **Books** India, Published September 2012.
2. Swami Vivekananda, "***Prosperous India"*** 1st edition, The Ramakirshna Mission Institute of Culture, 1937.
3. Sarvepalli Radhakrishnan, ***"The Source Book on Indian Philosophy"***, Princeton, N.J. : Princeton University Press, 1957.
4. Amartya Sen, ***"The Argumentative Indian",*** Allen Lane, Published 2005.

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SEMESTER VII

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U15AU*T*701 VEHICLE BODY ENGINEERING

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand various category of vehicle frames
CO2: Understand various types of vehicle body construction
CO3: Familiarize various aerodynamic effects of vehicle body shape

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M	S		M	S						S	S	M
CO2		M	S		M	S						S	S	M
CO3		M	S		M	S						S	S	

Course Assessment methods:

Direct	Indirect
1. Assignments	1. Course Exit Survey
2. Continuous assessment tests	
3. End-semester examination	

CAR BODY DETAILS **9 Hours**

Types Saloon, convertibles, Limousine, Estate Van, racing and sports car – Visibility: regulations, driver's visibility, tests for visibility – Methods of improving visibility and space in cars – Safety: safety design, safety equipments for car. Car body construction.

BUS BODY DETAILS **9 Hours**

Classification of bus bodies – Based on distance traveled, Based on capacity of the bus and based on style & shape. Types of metal section used in the construction and regulations. Construction of conventional and integral type buses& comparison.

COMMERCIAL VEHICLE DETAILS **9 Hours**

Classification of commercial vehicle bodies. Construction of Tanker body and Tipper body. Dimensions of driver seat in relation to controls. Driver cabin design for compactness.

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VEHICLE AERODYNAMICS **9 Hours**

Types of aerodynamic drag. Forces and moments influencing drag. Effects of forces and moments. Various body optimization techniques for minimum drag. Principle of wind tunnel technology. Flow visualization techniques. Testing with wind tunnel balance (scale models).

BODY MATERIALS, TRIM AND MECHANISMS **9 Hours**

Steel sheet, timber, plastics, GRP, properties of materials – Corrosion – Anticorrosion methods – Selection of paint – Modern painting process in details – Body trim items – Body mechanisms.

Theory :45 Hrs **Total Hours: 45**

References:

1. Powloski,J., Vehicle Body Engineering, Business Books Ltd., 1989.
2. Heinz Heisler, "Advanced Vehicle Technology", 2nd edition, Butterworth –Heinemann, 2002.
3. Wolf-Heinrich Hucho, "Aerodynamics of road vehicles", 4th edition, 2000.

Other references:

1. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd.,London, 1982.
2. Giles,G.J., Body construction and design, Illiffe Books Butterworth & Co., 1971.
3. Braithwaite,J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London, 1977.
4. Dieler Anselm., The passenger car body, SAE International, 2000

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U15GST006 **Product design and development**
(Common to all branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand the basic concepts of product design and development.
- Know the implications in product architecture and the importance of industrial design.
- Understand prototyping basics and influence of diverse factors on project success.

COURSE OUTCOMES:

CO1: Apply concepts of product development and outline product planning process

CO2: Apply relative importance of customer needs in establishing product specifications

CO3: Identify concept generation activities and summarize the methodology involved in concept selection and testing

CO4: Outline supply chain considerations in product architecture and understand the industrial design process

CO5: Apply design for manufacturing concepts in estimating manufacturing costs

CO6: Apply principles of prototyping in product development economics and highlight importance of managing projects

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		M		M					W			M	S
CO2			M											S
CO3	M		M											M
CO4			S			W				M	W		M	S
CO5			S		M	M							S	S
CO6					M				M		S		S	S

Course Assessment methods:

Direct		Indirect	
1	Assignment	**1**	Course End Survey
2	Internal Test		
3	Group presentation		
4	End Semester Examination		

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Course Content

INTRODUCTION - DEVELOPMENT PROCESSES AND ORGANIZATIONS –PRODUCT PLANNING 9 Hours

Characteristics of successful product development to Design and develop products, duration and cost of product development, the challenges of product development.

A generic development process, concept development: the front-end process, adapting the generic product development process, the AMF development process, product development organizations, the AMF organization. The product planning process, identify opportunities.

Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.

IDENTIFYING CUSTOMER NEEDS - PRODUCT SPECIFICATIONS 9 Hours

Gathering raw data from customers, interpreting raw data in terms of customer needs, organizing the needs into a hierarchy, establishing the relative importance of the needs and reflecting on the results and the process. Specifications, establish specifications, establishing target specifications setting the final specifications.

CONCEPT GENERATION - CONCEPT SELECTION - CONCEPT TESTING 9 Hours

The activity of concept generation clarify the problem search externally, search internally, explore systematically, reflect on the results and the process, Overview of methodology, concept screening, concept scoring, caveats. Purpose of concept test, choosing a survey population and a survey format, communicate the concept, measuring customer response, interpreting the result, reflecting on the results and the process.

PRODUCT ARCHITECTURE - INDUSTRIAL DESIGN - DESIGN FOR MANUFACTURING 9 Hours

Meaning of product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, is assessing the quality of industrial design. Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

PROTOTYPING - PRODUCT DEVELOPMENT ECONOMICS - MANAGING PROJECTS 9 Hours

Prototyping basics, principles of prototyping, technologies, planning for prototypes, Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis. Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.

Theory: 45 hours Total hours: 45

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REFERENCES:

1. Karl Ulrich,T, Steven Eppinger, D, “Product Design and Development”, McGrawHill, 2015.
2. Chitale, AK, Gupta, RC, “Product Design and Manufacturing” PHI, 2013.
3. Timjones, “New Product Development:An Introduction to a multifunctional process”, Butterworth-Heinemann, 1997.
4. Geoffery Boothroyd, Peter Dewhurst and Winston Knight,A, “Product Design for Manufacture and Assembly”, CRC Press, 2011.

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U15AU*P*701 **VEHICLE MAINTENANCE AND TESTING LABORATORY**

L	T	P	C
0	0	2	1

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Prepare the Workshop layout and statements
CO2: Understand about the tools and Equipments used in Automotive workshop
CO3: Troubleshoot and service various sub systems in the vehicle
CO4: Test the Vehicle performance

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M								M	M		W		S
CO2	M				M				M			M		S
CO3	M				M				M			W		S
CO4	M				M				M			W		S

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment	1. Course Exit Survey
2. Model Practical Examinations	
3. End Semester Practical Examinations	

LIST OF EXPERIMENTS:

1. Experimental Study and layout of an automobile repair, service and maintenance shop.
2. Experimental Study and preparation of different statements/records required for the repair and maintenance works.
3. Experimental Study about Tools and instruments used in the maintenance shop
4. Experimental Study about Gearbox, Braking, Steering, Suspension system Maintenance
5. Fault Diagnostics of LCV using Diagnostic kit

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6. Lighting System Trouble shooting & Servicing and Head Lights- Beam alignment
7. Fault diagnostics of Air-Conditioning system
8. Gearbox Trouble shooting & Servicing.
9. Braking System Troubleshooting & Servicing
10. Removal, fitting of tire and tube and Testing wheel balance
11. Testing of camber, caster, kingpin inclination, toe-in and toe-out
12. Performance Testing of Two Wheeler using 2-Wheeler Chassis Dynamometer
13. Performance Testing of Four Wheeler using 4-Wheeler Chassis Dynamometer
14. On-road Braking, Acceleration and Fuel economy test
15. On-road Vehicle handling test
16. Emission test on vehicles using Gas Analyzer and smoke meter

(Note:Experiments beyond the syllabus should be conducted)

Total Hours 30

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U15AU*P*702 PROJECT PHASE – I

L	T	P	C
0	0	4	2

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution related to automotive
CO2: Understand the project management techniques
CO3: Demonstrate their report writing and presentation skills

Pre-requisite:

1. Minimum of Six semester of courses

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	S	S
CO2											S		S	S
CO3										S			S	S

Course Assessment methods:

Direct	Indirect
1. Project reviews - 60%	1. Course Exit Survey
2. Project Report - 10 %	
3. End Semester review -30%	

GUIDELINES:

1. The Project work in Phase-I and II may contain a theoretical study and analysis, experimental analysis, design, modeling & simulation, fabrication of a model or a prototype or a combination of the above related to automotive area.
2. The project work may include literature review, modeling, analysis, simulation, fabrication, testing and analysis & correlation of test data etc.
3. Can be individual or a group project, with maximum of 3 students per group.
4. The progress of the project is evaluated based on a minimum of three reviews and end semester review.
5. In Phase-I of the project, literature survey, projects task plan and design phases should have been completed
6. A project report is required to be submitted at the end of the semester in the required format.
7. The review presentations and project report should contain the individual work allocation & contribution, estimated & actual time schedule with charts (PERT/GANTT), literature survey, drawings in addition to the details of project work carried out.

Total Hours 60

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U15AU*P*703

TECHNICAL & RESEARCH SKILLS DEVELOPMENT

L	T	P	C
0	0	2	1

COURSE OBJECTIVE

To inculcate and promote the technical and research skills of the students

- To participate in International / National level design / fabrication / project competitions
- To undergo in Internships / Industrial Trainings
- To involve in Research & Development activities
- To develop self learning attitude for lifelong learning
- To get trained in advanced areas or topics beyond curriculum

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Improve the skills of students in design & manufacturing by participating in national level design / fabrication competitions

CO2: Industry exposure to develop the knowledge in respective areas of interest

CO3: Developing research culture among students by motivating them to publish their work

CO4: Developing self learning and lifelong learning attitude

Pre-requisite:

1. Design and Manufacturing

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	S					S		S
CO2										S	S			
CO3										S	S			
CO4	S	S	S	S	S	M	S					S		S

Course Assessment methods:

Direct	Indirect
1. Certificates	1. Course Exit Survey

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Note:

1. Each student must complete any one of the following skill sets through self interest on his/her own.
2. Student can participate / undergo / publish for development of their technical skills through self learning at any point of time starting from third semester of engineering program and must be completed before the last working day of the 6th semester.
3. Evaluation will be based on the level, nature of the program/course/event participation and the awards/prizes won if any. Grades will be awarded accordingly.

SKILL SETS

1. Participate actively and contribute significantly in any one of the International or National level design, fabrication or project competitions organized by reputed professional bodies/organizations like the following events/competitions conducted by SAE, FMSCI, Autodesk, Altair, CII, NI, Bosch, Texas Instruments etc. Participation certificate is mandatory.
    a) m-BAJA / e-BAJA
    b) SUPRA / FSAE
    c) Go Kart, Electric Solar Vehicle, Quad bike. ATV vehicles by recognized professional bodies
    d) Autodesk Design Challenge, Altair Open Contest, NIyantra, Inscribe etc conducted by Industry or by any IIT's or NIT's.
2. Complete minimum of fifteen days full time In plant Training / Internships in any one of the following categories. Certificate from Industry is mandatory.
    Category 1. Summer Internships offered by any IIT's or NIT's
    Category 2. In Plant training / Internship at any automobile OEM's / allied industries
3. Paper publication in any one of the following categories
    Category 1. One International Journal publication
    Category 2. Two National Journal publications
    Category 3. Three paper presentations in International / National Conferences
4. Complete a certification course including online courses (like NPTEL, MOOCs, Coursevera, MIT etc) in any one of the following areas. The minimum duration of any certification courses should be 45 hrs conducted by institutions/organisations recognized by department.
    a. Design & Analysis training courses
    b. Manufacturing, Quality, Servicing or Testing training programs
    c. Technical / Managerial Courses related to Automotive

Total Hours 30

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U15GH*P*701/ GLOBAL VALUES	L	T	P	C
(Common to all branches of Engineering and Technology)	**1**	**0**	**0**	**1**

Objectives

1. To facilitate Students to think holistically
2. To empathize ecology and its benefits and thereby conserve it
3. To be aware of Issues related to Globalisation and how to mitigate it
4. To understand global economy and to know how economy driven world impacts happiness

Course outcomes:

After successful completion of the course, the student would be able to:

1. The Students shall understand importance of ecology and its preservations
2. The Students shall understand the various global issues and their causes and solutions
3. The Students shall approach any problem holistically as against giving a reductionist solution
4. The Students shall learn impact of globalization on various factors such as environment, local population etc
5. The Students shall learn to integrate and understand how an Individual peace impacts world peace

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		W					M	M	M	M		M		
CO2		W				M	S	S	M	M		M		
CO3		W	W		W	M	M	M	W	W		M		
CO4		W				S	M	M	W	W		M		
CO5						W	W	W				S		

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Course Assessment methods:

Direct	Indirect
1.Individual Assignment 2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	1.Attendance and Behavioural Assessment

Introduction to Global Values	1 Period
Introduction to Systems Thinking	1 Period
Ecology, ecological imbalances and its solution	3 Periods
Globalisation Vs Localisation – an economic and Spiritual Perspective	3 Periods
Global Issues & Solutions	3 Periods
Advanced Contemplative Practices	4 Periods

Total Periods: 15

References Books:

1. Vethathiri's Maharishi's, ***"World peace"*** The World Community Service Centre, Vethathiri Publications,1957.
2. Fritz Schumacher, ***"Small is Beautiful",*** The Blond & Briggs, Published 1973.
3. Noam Chomsky, ***"Profit over People",*** Seven Stories Press, Published 1999.
4. Vethathiri's Maharishi's, ***"Atomic Poison"*** The World Community Service Centre, Vethathiri Publications, 1983.

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SEMESTER VIII

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U15AU*P*801 PROJECT PHASE – II

L	T	P	C
0	0	20	10

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution related to automotive
CO2: Understand the project management techniques
CO3: Demonstrate their report writing and presentation skills

Pre-requisite:

1. Minimum of Six semester of courses

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	S	S
CO2											S		S	S
CO3										S			S	S

Course Assessment methods:

Direct	Indirect
1. Project reviews 50%	1. Course Exit Survey
2. Project report 10%	
3. Viva Voce 40%	

GUIDELINES:

1. To continue the Phase- I project and executing the same in consultation with the project coordinator and project guide
2. A Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment is a must to complete and an effort leading to paper publication or patenting is desired.
3. A working model or prototype is to be submitted for end semester evaluation
4. A project report is required to be submitted at the end of the semester in the required format.
5. The review presentations and project report should contain the individual work allocation & contribution, estimated & actual time schedule with charts (PERT/GANTT), literature survey, drawings, analysis report, DFMEA/FMEA charts in addition to the details of project work carried out.
6. Project work done at Industry should be duly supported by certificate from the Industry.
7. The progress of the project is evaluated based on a minimum of three reviews and end semester viva-voce examination.

Total Hours 300

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ELECTIVES

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PROFESSIONAL ELECTIVES

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U15AU*T*E01 AUTOMOTIVE AERODYNAMICS

L	T	P	c
3	0	0	3

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the importance aerodynamics for automobiles

CO2: Apply the concept of wind tunnel for aerodynamic design of automobiles.

CO3: Analyze various aerodynamic shapes of car.

Pre-requisite:

1. Fluid Mechanics
2. Vehicle Body Engineering

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W	M	M	S					M	S		M	
CO2	S	S	S	M	M					M	S		S	
CO3	S	S	S	M	M					M	S		S	

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Project	
3. End Semester Examination	

INTRODUCTION **9 Hours**

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

AERODYNAMIC DRAG OF CARS **9 Hours**

Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

SHAPE OPTIMIZATION OF CARS **9 Hours**

Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners.

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VEHICLE HANDLING **9 Hours**

The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles.

WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS **9 Hours**

Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

Theory :45 Hrs **Total Hours: 45**

References:

1. Hucho.W.H. - "Aerodynamic of Road Vehicles" - Butterworths Co., Ltd., - 1997.
2. Pope - "Wind Tunnel Testing " - John Wiley & Sons - 2nd Edition, New York - 1974.
3. Automotive Aerodynamic: Update SP-706 - SAE – 1987

Other references:

1. Vehicle Aerodynamics - SP-1145 - SAE – 1996.

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U15AU*TE*02 COMPUTATIONAL FLUID DYNAMICS

L	T	P	c
3	0	0	3

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand discretisation process of governing equation
CO2: Understand grid generation and its application
CO3: Understand different mathematical modules used in CFD
CO4: Understand Turbulence Energy Equation in mathematical form
CO5: Able to model and analyse fluid flow and heat transfer problems using commercial CFD packages.

Pre-requisite:

1. Fluid Mechanics
2. Numerical Methods

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	M	M		M						M	S	
CO2	S	S	M	M		M						M	S	
CO3	S	S	M	M		M						M	S	
CO4	S	S	M	M		M						M	S	
CO5			M	W	S					M		S	S	

Course Assessment methods:

Direct	Indirect
1. Tests	1. Course Exit Survey
2. End-Semester Examination	
3. Project Evaluation	

INTRODUCTION **8 Hours**

Application areas of CFD, Basic concepts of fluid flow - Governing equations, conservation of mass, momentum and energy – Navier-stokes and energy equation for Newtonian fluid, Mathematical classification of flow - Hyperbolic, parabolic, elliptic and mixed flow types.

DISCRETISATION **13 Hours**

Finite difference method - Forward, backward and central difference schemes, explicit and implicit methods - Numerical solution for heat transfer and fluid flow problems for steady state and transient conditions, stability analysis and error estimation. Grid generation - Choice of grid, grid oriented velocity components, cartesian velocity components, staggered and collocated arrangements.

CFD TECHNIQUES **9 Hours**

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Lax - Wendroff technique, MacCormack's technique, relaxation technique. ADI technique, pressure correction technique, SIMPLE algorithm. Fluid flow and convection problems - Upwind scheme and stability criteria.

TURBULENCE MODELING **9 Hours**

Turbulence energy equation - One-equation model, k-ω model and k- ε model.

CASE STUDIES **5 Hours**

Modelling and analysis of heat transfer, fluid flow and automobile components using CFD packages

Theory :45 Hrs **Total Hours: 45**

References:

1. John D Anderson, " Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New York, 1995.
2. Muralidhar K and Sundararajan T, "Computational Fluid Flow and Heat Transfer", Narosa Publications, New Delhi, 2003.
3. Chung T.J, "Computational Fluid Dynamics", Cambridge University Press, London, 2002.
4. David C Wilcox, "Turbulence Modeling for CFD", DCW Industries, Inc, 1993.

Other references:

1. Versteeg H.K and Malalasekara W, "An Introduction to Computational Fluid Dynamics - The Finite Volume Method', Longman, 1995.

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U15AU*TE*03

VEHICLE CONCEPT DESIGN AND STYLING

L	T	P	c
3	0	0	3

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the difference between geometric versus naturalistic drawing

CO2: Ability to create and innovate different Automotive shapes and to validate them

CO3: Able to visually present by using different colors, sketches and to increase the aesthetic sense of vehicles.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M				M					M		M	S	
CO2	S	M	M	W	M					M		M	S	

Course Assessment methods:

Direct	Indirect
1. Internal Test	1. Course Exit Survey
2. Assignment/Presentation/Seminar	
3. Semester Exam	

INTRODUCTION **9 Hours**

Drawing in product design, drawing by hand, drawing by computer, mass production, geometric versus naturalistic drawing, modernist design. Basic drawing skills - Perspectives, metric projections, spherical projections, orthographic projections, sections and scrap views. Tools and materials - Pencils, pens, erasers, markers, paints, ink, airbrush, drawing instruments, paper and aboard.

COMPUTER SYSTEMS **9 Hours**

The computer processor, system software, the central processing unit, memory, frame buffers, display, input devices, hardcopy output, 3D output devices, networking, health and safety. Concept design - Satisfying the client, sketch, schematic, evaluating the design, 3D modelling concepts, hybrid approach, commercial computer solutions, drawing in space, creating organic forms.

PRESENTATION DRAWING AND VISUALS **9 Hours**

From water colour washes to markers, painting by numbers, the art of design, visual tricks, making marker drawing, 2D computer programs: paint and vector, 3D computer aided styling (CAS), creating virtual reality, shading a computer model, ray tracing and radiosity, adding texture, fractals and commercial modelers.

FROM GENERAL ARRANGEMENTS DRAWING TO PRODUCTION **9 Hours**

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Technical production documentation, the general arrangement drawing, drafting standards, computer aided drafting, geometric constructions, controlling curves, parametric design, CAD data - Exchange standards and all change in the CAD market.

TECHNICAL ILLUSTRATION **9 Hours**

Art of technical illustration, techniques of technical illustration, thick and thin lines, sections, cutaways and ghosting, photo-tracing, annotation and labeling, computer aided illustration, interactive technical illustration and commercial solutions.

Theory :45 Hrs **Total Hours: 45**

References:

1. Alan Pipes, “Drawing for Designers”, Laurence King Publishing, 2007
2. Erik Olofsson, Klara Sjölén, “Design Sketching”, Keeos Design Books AB, 2005
3. Tony Lewin, Ryan Borroff, “How to Design Cars Like a Pro”, MotorBooks International, 2010.

Other references:

1. Stuart Macey, Geoff Wardle, Ralph Gilles, Freeman Thomas, Gordon Murray , “H-Point: The Fundamentals of Car Design & Packaging”, Design Studio Press, 2009.

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U15AU*T*E04 **DESIGN FOR MANUFACTURE AND ASSEMBLY**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the basic background of DFM and related concepts
CO2: Understand the fundamentals of GD &T
CO3: Understand tolerance charting
CO4: Apply the concept of DFM
CO5: Understand the concept of selective assembly

Pre-requisite:

1. Manufacturing Technology

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													S
CO2	S	S												S
CO3	S	S	M							S				S
CO4	M			S										S
CO5	S									S				S

Course Assessment methods:

Direct	Indirect
1. Internal Test	1. Course Exit Survey
2. Assignment	
3. Semester Exam	

DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY **9 Hours**

DFM approach, DFM guidelines, standardization, group technology, Value Engineering, comparison of materials on Cost basis.

GEOMETRIC DIMENSIONING & TOLERANCE INTRODUCTION **9 Hours**

Process capability, process capability metrics, Cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law, 6σ concept.

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TOLERANCE CHARTING TECHNIQUE **9 Hours**

Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

DESIGN FOR MANUFACTURE **9 Hours**

Design features to facilitate machining, datum features - Functional and manufacturing, component design-machining considerations, redesign for manufacture, examples Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – Case studies.

SELECTIVE ASSEMBLY **9 Hours**

Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples

Theory :45 Hr **Total Hours: 45**

References:

1. Harry Peck, "Designing for Manufacture", Pitman Publications, London, 1983.
2. Krulikowski A, “Fundamentals of Geometric Dimensioning and Tolerancing, Delmar Publishers, New York, 1991
3. Spotts M. F, "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., New Jersey, 1983.
4. Geoffrey Boothroyd ,Peter Dewhurst , Winston A. Knight , "Product Design for ıcture and Assembly", CRC press, Taylor and Francis, 2010
4. James G Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1983.
5. Trucks H E, "Design for Economic Production", Society of Manufacturing Engineers, Michigan, 1987.

Other references:

1. Oliver R Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc., New York, 1967.
2. Creveling C. M, "Tolerance Design - A Hand Book for Developing Optimal Specifications", Addison Wesley Longman Inc.,USA, 1997.
3. Pahl.G and Beitz .W, "Engineering Design-Systematic Approach", Springer Verlag Publications, 1996.

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U15AU*T*E05 **COMPUTER SIMULATION OF IC ENGINE PROCESSES**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the significance of various processes in I.C Engines.
CO2: Apply the simulation techniques for modification of combustion chamber
CO3: Apply the simulation techniques to develop new engine concept

Pre-requisite:

1. U15AUT302-Thermodynamics and Thermal Engineering

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W	M	M	M	M				M	W	M		S	
CO2	M	S	W	M	S				M	W	M		S	
CO3	M	S	W	M	S				M	W	S		S	

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Internal Test	
3. End Semester Examination	

INTRODUCTION **9 Hours**

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 & CI engine simulation.

COMBUSTION AND STOICHIOMETERY **9 Hours**

Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air required for combustion, excess air supplied and stoichiometric air required for complete combustion. Conversion of volumetric analysis to mass analysis.

ADIABATIC FLAME TEMPERATURE **9 Hours**

Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic

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changes of state. SI Engine simulation with air as working medium, deviation between actual and ideal cycle

SIMULATION OF IC ENGINES **9 Hours**

SI and CI engine simulation – Air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – Part throttle, full throttle and supercharged conditions

SIMULATION OF NEW ENGINE CONCEPT **9 Hours**

Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine and controlled auto ignition engine.

Theory :45 Hrs **Total Hours: 45**

References:

1. Ganesan,V., Computer Simulation of spark ignition engine process, Universities Press (I) Ltd., Hyderabad, 1996.
2. Ganesan V, "Computer Simulation of Compression-Ignition Engine Processes", University Press (I) Ltd, Hyderabad, 2000
3. Ramoss,A.L., Modelling of Internal Combustion Engines Processes, McGraw Hill Publishing Co., 1992.
4. Benson,R.S., Whitehouse,N.D., Internal Combustion Engines, Pergamon Press, Oxford, 1979.

Other references:

1. Ashley Campbel, Thermodynamics analysis of combustion engines, John Wiley & Sons, New York, 1986.

Signature of BOS chairman, Auto

U15AU*T*E06

NOISE, VIBRATION AND HARSHNESS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the theory of sound.
CO2: Analyze various sources of vibration and methods of damping
CO3: Apply the concept of design of interiors to maintain NVH levels.

Pre-requisite:

1. Engineering Mechanics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W										M	S	
CO2	S	M	W									M	M	
CO3	S	M	M	W								M	M	

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Internal Test	
3. End Semester Examination	

8 Hours

FUNDAMENTALS OF ACOUSTICS, NOISE AND VIBRATION

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

EFFECT OF NOISE, BLAST, VIBRATION AND SHOCK ON PEOPLE

7 Hours

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

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TRANSPORTATION NOISE AND VIBRATION – SOURCES, PREDICTION AND CONTROL **10 Hours**

Introduction to Transportation Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire/Road Noise—Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

INTERIOR TRANSPORTATION NOISE AND VIBRATION – PREDICTION AND CONTROL **10 Hours**

Introduction to Interior Transportation Noise and Vibration Sources, Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors—Prediction and Control.

NOISE AND VIBRATION TRANSDUCERS, ANALYSIS EQUIPMENT, SIGNAL PROCESSING AND MEASURING TECHNIQUES **9 Hours**

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

Theory :45 Hrs **Total Hours: 45**

References:

1. Allan G. Piersol ,Thomas L. Paez “Harris’ shock and vibration hand book” , McGraw-Hill , New Delhi, 2010
2. Clarence W. de Silva , “Vibration Monitoring, Testing, and Instrumentation”, CRC Press, 2007
3. David A.Bies and Colin H.Hansen “Engineering Noise Control: Theory and Practice” Spon Press , London . 2009

Other references:

1. Colin H Hansen “Understanding Active Noise Cancellation” , Spon Press , London. 2003
2. Matthew Harrison “Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles”, Elsevier Butterworth-Heinemann, Burlington, 2004
3. Xu Wang, “Vehicle Noise and Vibration Refinement”, CRC Press, 2010

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U15AU*T*E07 COMBUSTION ENGINEERING

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand Types and properties of fuel
CO2: Understand basic thermodynamics and kinetics of combustion
CO3: Understand Combustion theory of solid, liquid and gaseous fuel.

Pre-requisite:

1. Engineering Chemistry
2. Thermodynamics and Thermal Engineering

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W				W						M	M	
CO2	S	M	W			W						M	S	
CO3	S	W	M			W						M	S	

Course Assessment methods:

Direct	Indirect
1. Assignments	1. Course Exit Survey
2. Presentations	
3. End-Semester Examination	

INTRODUCTION **9 Hours**

Historical perspective of combustion science – perspective of fuels and combustion technology. Types and general characteristics of fuels – proximate and ultimate analysis of fuels. ROM, DMMF, DAF and bone dry basis. Moisture and heating value determination – gross and net hearting values – claorimetry, DuLong's formula for HV estimation, Flue gas analysis – Orsat apparatus.

FUEL TYPES **9 Hours**

Solid Fuels: Peat – coal – biomass – wood waste – agro fuels – refuse derived solid fuel – testing of solid fuels. Bulk and apparent density – storage – washability – coking and caking coals. Liquefaction of solid fuels.
Liquid Fuels: Refining – molecular structure – liquid fuel types and their characteristics – fuel quality.
Gaseous Fuels: Classification and characterization.

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THERMODYNAMICS AND KINETICS OF COMBUSTION **9 Hours**

Properties of mixture – combustion stoichiometry – chemical energy – chemical equilibrium and criteria – properties of combustion products. First law combustion calculations – adiabatic flame temperature (analytical and graphical methods) – simple second law analysis. Elementary reactions – chain reactions – pre-ignition kinetics – global reactions – kinectics – reaction at solid surface.

COMBUSTION OF SOLID FUELS **8 Hours**

Drying - devolatilization - char combustion. Fixed bed combustion - suspension burning - fluidized bed combustion.

COMBUSTION OF LIQUID AND GASEOUS FUELS **10 Hours**

Spray formation and droplet behaviour - oil fired furnace combustion - gas turbine spray combustion – direct and indirect Injection combustion in IC engines. Energy balance and furnace efficiency – gas burner types - pulse combustion furnace. Premixed charge engine combustion. Detonation of gaseous mixtures.

Theory :45 Hrs **Total Hours: 45**

References:

1. Kuo, K.K., Principles of Combustion, 2nd Edition, John Wiley and Sons, Inc., 2005.
2. Annamalai, K and Puri, I.K, Combustion science and Engineering, CRC Press, 2007
3. Borman, G.L. and Ragland, K.W., Combustion Enginnering, McGrawHill International Editions, 1998.
4. Samir Sarkar, Fuels and Combustion, 2nd Edition, Orient Longman, 1990

Other references:

1. Sharma SP and Mohan Chander, Fuels and Combustion, Tata Mcgraw Hill, 1984.
2. Bhatt, B.I and Vora, S.M., Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1996
3. Clive Davis, Calculations in Furnace Technology, Pergamon Press, Oxford, 1970.

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U54AU*T*E08 ALTERNATE FUELS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand and identify the alternatives to conventional gasoline and diesel fuels
CO2: Performance investigation and comparison of alternate fuels
CO3: Understand the working of multi fuel engine

Pre-requisite:

1. Fuels and Lubricants

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S		M	S	S					S	S	
CO2	S	S	S										S	
CO3	S		M		M	S	S					M	M	

Course Assessment methods:

Direct	Indirect
1. Assignments	1. Course Exit Survey
2. Continuous assessment tests	
3. End-semester examination	

GASEOUS FUELS **10 Hours**

Properties, composition, production, storage, engine modifications, combustion, performance and emission characteristics in SI and CI engines, advantages and disadvantages of compressed natural gas (CNG), liquefied petroleum gas (LPG), hydrogen and ammonia.

ALCOHOL FUELS **10 Hours**

Properties, composition, production, storage, engine modifications, blends, combustion, performance and emission characteristics in SI and CI engines, advantages and disadvantages of methanol ethanol and butanol.

BIO-FUELS **9 Hours**

Properties, composition, production, engine modifications, treatment, blends, performance and emission characteristics, advantages and disadvantages of straightvegetable oils, bio-diesel and biogas.

SYNTHETIC FUELS **8 Hours**

Properties, composition, material compatibility, engine modifications, performance and emission characteristics, advantages and disadvantages of hydrogen with CNG, dimethyl ether (DME), diethyl ether (DEE), syngas, producer gas and plastic fuel.

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DUAL-FUEL AND MULTI-FUEL ENGINES **8 Hours**

Technology, working principle, conversion of engine, operation, combustion, performance and emission characteristics, advantages and disadvantages.

Theory :45 Hr **Total Hours: 45**

References:

1. Thipse S.S., "Alternate Fuels – Concepts, Technologies and Developments", Jaico Publishing House, Delhi, 2010.
2. Richard L. Bechfold, "Alternative Fuels Guide Book", SAE International, Warrendale, 1997.
3. Ganesan V. "Internal Combustion Engines", Tata Mc-graw Hill Publishing Co. Ltd., New Delhi, 2012.
4. Mathur L and Sharma R.P, "Internal Combustion Engines", DhanpatRai Publications (P), Ltd, New Delhi, 2002.

Other references:

1. "Alcohols as motor fuels progress in technology", Series No.19, SAE Publication, USA, 1980.

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U15AU*T*E09

HYDRAULIC AND PNEUMATIC SYSTEMS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the graphical representation, construction and working of the components of the pneumatic and hydraulic systems

CO2: Understand and build pneumatic and hydraulic circuits

CO3: Understand the working of Automotive pneumatic systems

CO4: Understand the working of Automotive hydraulic systems

CO5: Analyze and correlate the circuits and programming

Pre-requisite:

1. Fluid Mechanics and Machinery

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M								S			M	W
CO2			S										M	M
CO3			S										M	M
CO4					S								M	M
CO5			S		S								S	

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Internal tests	
3. End semester exam	

INTRODUCTION TO FLUID POWER & PRINCIPLE **9 Hours**

Introduction to fluid power control- Hydraulic and Pneumatics- Selection criteria, application of fluid power, application of Pascal's law, equation, Transmission and multiplication of force pressure losses- fluids, selection and properties- ISO symbols

FLUID POWER DRIVES **12 Hours**

Fluid power drives- Pumps- working principle and construction details of gear, vane and piston pumps, hydraulic motor, Hydrostatic transmission drives and characteristics- Hydraulic supply components- Pneumatic power supply- Compressor, air distribution, air motors. Case study related to automotive application

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FLUID POWER ELEMENTS **12 Hours**

Control valves- pressure, flow direction- working principles and construction- Special type valves- proportional and servo- Selection and actuation methods.

Actuators- Selection and specification, cylinders- mounting, cushioning, - Fluid conditioning elements- Accumulators. Case study related to automotive application.

HYDRAULICS AND PNEUMATICS CIRCUITS DESIGN **9 Hours**

Design of Hydraulic and Pneumatic circuits for automation, Selection and specification of circuit components, sequencing circuits, cascade and Karnaugh- Veitch map method- Regenerative, speed control, Synchronizing circuits. Case study related to automotive application.

AUTOMOTIVE APPLICATIONS **9 Hours**

Use of electrical timers, switches, solenoid, relay, proximity sensors- Electro pneumatic sequencing Ladder diagram- PLC: – elements, function and selection- PLC programming- Ladder and different programming methods- Sequencing circuits. Case study related to automotive application.

Theory :45 Hr **Total Hours: 45**

References:

1. Anthony Esposito, “Fluid power with applications” , 5th Edition, Pearson Education 2003.
2. Majumdar, “ Oil Hydraulics: Principles and Maintenance”, Tata McGraw Hill, 2004
3. Majumdar, “Pneumatic system: Prinicples and maintenance”, Tata McGraw Hill,2004
4. Andrew Parr, “ Hydraulics & Pneumatics” Jaico Publishing House,2004

Other references:

1. William W.Reaves, “Technology of Fluid Power”, Delmer Publishers,1997
2. Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, Chand & Co, 2006.
3. Peter Rohner,” Fluid Power Logic circuit Design” MacMillion Press Ltd., 1990.
4. Micheal J, Pinches and Ashby, J.G., “Power Hydraulics”, Prentice Hall, 1989.
5. Dudelyt, A Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.

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U15AU*T*E10

COMPOSITE MATERIALS AND STRUCTURES

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Advantages and Properties of Composite Materials.
CO2: Apply the composite materials in Automotive Application.
CO3: Analyze the Material properties and Failure criteria for Composites
CO4: Select the Materials and Design the Sandwich Construction
CO5: Understand the fabrication of fibers

Pre-requisite:

1. Materials Science

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W		S											
CO2	S		S				W						S	
CO3	S	S	S										S	
CO4	S	S	S				W						S	
CO5	W		S											S

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment Test	1. Course Exit Survey
2. Assignments	
3. End Semester Examination	

STRESS STRAIN RELATION **6 Hours**

Introduction- Advantages and application of composite materials, reinforcements and matrices – Generalized Hooke's Law – Elastic constants for anisotropic, orthotropic and isotropic materials.

METHODS OF ANALYSIS **12 Hours**

Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of material properties. Experimental characterization of lamina.

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LAMINATED PLATES **12 Hours**

Governing differential equation for a general laminate, angle ply and cross ply laminates. Failure criteria for composites.

SANDWICH CONSTRUCTIONS **8 Hours**

Basic design concepts of sandwich construction -Materials used for sandwich construction - Failure modes of sandwich panels.

FABRICATION PROCESS **7 Hours**

Various Open and closed mould processes. Manufacture of fibers – Types of resins and properties and applications – Netting analysis.

Theory :45 Hrs **Total Hours: 45**

References:

1. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
2. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.
3. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.

Other references:

1. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.

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U15AU*T*E11

AUTOMOTIVE COMPONENTS MANUFACTURING

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Manufacturing Processes of Automotive Engine components

CO2: Understand the Manufacturing Processes of Transmission system components

CO3: Understand the Heat Treatment and surface treatment methods used for Engine and Transmission system Components Manufacturing

CO4: Understand the Automotive vehicle Body and Electrical system Components Manufacturing Process

CO5: Understand the surface Coating Processes used in Automotive Industry

Pre-requisite:

1. Materials Science
2. Automotive Manufacturing Technology

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W		S			M								S
CO2	W		S			M	S							S
CO3	W		S			M								S
CO4	W		S			M	S							S
CO5	W		S			M	S							S

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment Test	1. Course Exit Survey
2. Assignments	
3. End Semester Examination	

ENGINE COMPONENTS **10 Hours**

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

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TRANSMISSION COMPONENTS-I **8 Hours**

Manufacturing of friction plates using conventional blanking and fine blanking. Manufacture of composite friction lining, composite moulding of phenol formaldehyde lining. Casting of gear box casing, precision forging of gears, gear hobbing, shaping, powder metallurgy, orbital forming of spur, helical, and bevel gears, hypoid gears, heat treatment and finishing.

TRANSMISSION COMPONENTS-II **8 Hours**

Continuous casting of propeller shaft, extrusion of propeller shaft, heat treatment and surface hardening of propeller shaft, Composite propeller shaft manufacturing. Forging of rear axles, casting of rear axle casing, wheels, brake drum- Tyre manufacturing

BODY COMPONENTS **10 Hours**

Introduction, thermoforming and hydro forming, press forming, welding of body panels, resistance welding and other welding processes. Introduction to injection moulding- injection moulding of instrument panel, moulding of bumpers, Reinforced Reaction Injection moluding, tooling and tooling requirements, manufacture of metal/polymer/metal panels. Adhesives and sealants, leaf spring manufacturing, Composite leaf springs, Wrap forming of coil springs.

SURFACE COATINGS AND ELECTRICAL COMPONENTS **9 Hours**

Chemical Vapour deposition, Physical Vapour deposition, sol-gel processing, Spraying, Plating, paining in paint booth.

Manufacturing of Starter motor, alternator, regulator, battery, lamps, control switches, electronic gauges.

Theory :45 Hrs **Total Hours: 45**

References:

1. Philip F. Ostwald & Jairo Munuz, “Manufacturing Processes and Systems”, John Wiley & Sons, New York, 1998.
2. Degarmo E.P., “Materials and process in Manufacturing”, Macmillan Publishing Co., 1997.
3. Heldt P.M., “High Speed Combustion Engines”, Oxford IBH publishing Co., Calcutta, 1996.

Other references:

1. Kalpakjian, “Manufacturing and Engineering and Technology”, Addison Wesloy, Publishing Company, 1995.
2. Sanjay K Mazumdar, “Composites Manufacturing”, CRC Press, NY, 2003.

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U15AU*T*E12

UNCONVENTIONAL MACHINING PROCESSES

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the need for the processes and classification
CO2: Understand the processes that use Mechanical energy
CO3: Understand the processes that use Electrical energy
CO4: Understand the processes that use chemical and Electro- chemical energy
CO5: Understand the processes that use Thermal energy

Pre-requisite:

1. Manufacturing Technology

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													S
CO2			S		M	M						S		S
CO3			S		M	M						S		S
CO4			S		M	M						S		S
CO5			S		M	M						S		S

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment Test	1. Course Exit Survey
2. Assignments	
3. End Semester Examination	

INTRODUCTION **5 Hours**

Unconventional machining Process – Need – classification – Brief overview.

MECHANICAL ENERGY BASED PROCESSES **10 Hours**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications

ELECTRICAL ENERGY BASED PROCESSES **8 Hours**

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

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CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES **12 Hours**

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants-maskant-techniques of applying maskants-Process Parameters – Surface finish and MRR-Applications. Principles of ECM-equipments-Surface Roughness and MRR-Electrical circuit-Process Parameters-ECG and ECH - Applications.

THERMAL ENERGY BASED PROCESSES **10 Hours**

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

Theory :45 Hrs **Total Hours: 45**

References:

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi (2007).

3. Carl Sommer Non-Traditional Machining Handbook, Advance Publishing(TX), January 1, 2009

4. Hassen Abdel & Gawad El-Gofy,Advanced Machining Processes,Mc graw Hill (Machanical Engineering series),2005

Other references:

1. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition, 2001.

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U15AUTE13 **ADDITIVE MANUFACTURING AND TOOLING**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the stages of product development

CO2: Understanding the concepts of STEREO LITHOGRAPHY AND DIRECT METAL LASER SINTERING processes

CO3: Understanding the concepts of FUSION DEPOSITION MODELING AND LAMINATED OBJECT MANUFACTURING and the machine details

CO4: Understanding the concepts of SOLID GROUND CURING and 3D printing processes and the machine details

CO5: Understanding the concepts of Rapid Tooling and the medical applications of RPT

Pre-requisite:

1. Manufacturing Technology

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S										M		S	M
CO2			S		S		M						S	M
CO3			S		S		M						S	
CO4			S		S		M						S	W
CO5			S		S		M						S	W

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Internal tests	
3. End semester exam	

PRODUCT DEVELOPMENT STAGES **9 Hours**

Introduction: Need for time compression in product development, Product development - conceptual design - development - detail design - prototype - tooling.

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STEREO LITHOGRAPHY AND DIRECT METAL LASER SINTERING **9 Hours**

Classification of RP systems, Stereo lithography systems - Principle - process parameters - process details - machine details, Applications. Direct Metal Laser Sintering (DMLS) system - Principle - process parameters - process details - machine details, Applications.

FUSION DEPOSITION MODELING AND LAMINATED OBJECT MANUFACTURING **9 Hours**

Fusion Deposition Modeling - Principle - process parameters - process details - machine details, Applications. Laminated Object Manufacturing - Principle - process parameters - process details - machine details, Applications.

SOLID GROUND CURING **9 Hours**

Solid Ground Curing - Principle - process parameters - process details - machine details, Applications. 3-Dimensional printers - Principle - process parameters - process details – machine details, Applications, and other concept modelers like thermo jet printers, Sander's model maker, JP system 5, Object Quadra system.

RAPID TOOLING **9 Hours**

Laser Engineering Net Shaping (LENS), Ballistic Particle Manufacturing (BPM) - Principle. Introduction to rapid tooling - direct and indirect method, software for RP - STL files, Magics, Mimics. Application of Rapid prototyping in Medical field.

Theory :45 Hrs **Total Hours: 45**

References:

1. Pham, D.T&Dimov.S.S, 2001, Rapid manufacturing, Springer-Verlag, London.
2. Amit Bandyopadhyay, Susmita Bose, "Additive Manufacturing"CRC press,Taylor & Francis, September 8, 2015
3. Ian Gibson, David W. Rosen, Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" by Springer,December 1st 2009
4. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim,"Rapid Prototyping: Principles and Applications", World Scientific- Technology & Engineering , 2010

Other references:

1. Terry wohlers, Wohlers Report 2000, Wohlers Associates, USA.
2. Chee Kai Chua (NTU, Singapore), Kah Fai Leong (NTU, Singapore), "3D Printing and Additive Manufacturing-Principles and Applications ,Fourth Edition of Rapid Prototyping ,4th Edition

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U15AU*T*E14 HEAT TRANSFER

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the basic concepts of modes of heat transfer
CO2: Analyze 1-D, 2-D and extended surface heat conduction problems
CO3: Analyze free and forced convection problems
CO4: Analyze of radiation problems
CO5: Analyze of heat exchanger problems

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	W	W	M								M	S	
CO2	S	W	W	M								M	S	
CO3	S	W	W	M								M	S	
CO4	S	W	W	M								M	S	
CO5	S	W	W	M								M	S	

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Internal tests	
3. End semester exam	

CONDUCTION **12 Hours**

Basic Concepts of Heat Transfer: Application areas of heat transfer, modes of heat transfer.
Conduction: one-dimensional and multi-dimensional heat conduction equations for various geometries, steady state heat conduction with 1-D and 2-D, heat transfer from extended surfaces, transient heat conduction – Lumped system analysis, spatial effects - exact solution, semi-infinite solid, numerical solution for steady state and transient heat conduction.

CONVECTION **11 Hours**

Classification of fluid flows, concepts of boundary layers - Velocity and thermal, external forced convection - Similarity solution, flow over flat plates, flow across cylinders and spheres, internal forced convection - Laminar and turbulent flow in tubes, convective correlations for circular and non-circular geometry, natural convection - Influence of vertical and horizontal surfaces, parallel plate channels and enclosures

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RADIATION **11 Hours**

Radiation process and properties, emissive power and black body radiation, shape factor, radiation heat transfer: between surfaces, two-surface enclosures, for back, diffuse and gray bodies, radiation shield.

HEAT EXCHANGERS **11 Hours**

Single and multi tube - Parallel, counter and crossflow heat exchangers, overall heat transfer coefficient, effectiveness method (NTU) to study performance of heat exchangers, fouling factor, compact heat exchangers, heat pipes.

Theory :45 Hr **Total Hours: 45**

References:

1. Yunus A Cengel, “Heat and Mass Transfer – A Practical Approach”, Tata McGraw Hill, New Delhi, 2007.
2. Holman J P, "Heat Transfer", McGraw Hill Inc., New York, 2001.

Other references:

1. Frank P. Incropera, Theodore L. Bergman, Adrienne S. Lavine, David P. DeWitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, New Delhi, 2011.

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U15AU*T*E15

DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

(Approved Design Data Book is Permitted)

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understanding the jigs and fixtures and need for them
CO2: Understand and design the different types of jigs
CO3: Understand and design the different types of Fixtures
CO4: Understand the different types of presses and their elements
CO5: Design of different types of dies

Pre-requisite:

1. Manufacturing Technology

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		S		M										
CO2	S		S								M		S	
CO3	S		S								M		S	
CO4		M	S										S	
CO5	S		S								M		S	

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Internal tests	
3. End semester exam	

PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES **8 Hours**

Tool design objectives - Production devices - Inspection devices - Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures-Mechanical actuation-pneumatic and hydraulic actuation-Analysis of clamping force-Tolerance and error analysis.

JIGS **9 Hours**

Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air operated Jigs components. Design and development of Jigs for given components.

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FIXTURES 9 Hours

General principles of boring, lathe, milling and broaching fixtures- Grinding, Assembly, Inspection and welding fixtures- Modular fixtures. Design and development of fixtures for given component

PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAY OUT 10 Hours

Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies: Die block-die shoe. Bolster plate-punch plate-punch holder-guide pins and bushes – strippers –knockouts-stops –pilots-Selection f standard die sets strip lay out-strip lay out calculations

DESIGN AND DEVELOPMENT OF DIES 9 Hours

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies- drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

Theory :45 Hrs **Total Hours: 45**

References:

1. Edward G Hoffman, Jigs & Fixture Design, Thomson – Delmar Learning, Singapore 2004
2. Donaldson. C, Tool Design, Tata McGraw-Hill, 1986
3. Kempster, “Jigs & Fixtures Design, The English Language Book Society”, 1978
4. Joshi, P.H., “Jigs & Fixtures, Second Edition”, Tata McGraw-Hill Publishing Company Limited, New Delhi 2004

Other references:

1. Hiram E Grant, ‘ Jigs and Fixture’ Tata McGraw-Hill, New Delhi, 2003
2. Fundamentals of Tool Design, CEEE Edition, ASTME, 1983
3. PSG College of Technology, Coimbatore - Design Data Handbook.

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U15AU*T*E16 VIRTUAL INSTRUMENTATION

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Lab view programming and its interfacing

CO2: Model Automotive systems

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M							M	
CO2	M				S						S	M	S	

Course Assessment methods:

Direct	Indirect
1. Lab Experiments	1. Course Exit Survey
2. Projects	

INTRODUCTION **9 Hours**

Virtual Instrumentation-Definition and flexibility-Block diagram and Architecture of Virtual Instrumentation- Virtual instruments versus Traditional Instruments- Review of software in virtual Instrumentation- VI programming techniques- VI, sub VI, Loops and charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, string and File Input / Output.

DATA ACQUISITION IN VI **9 Hours**

A/D and D/A Converters, plug-in Analog input / Output cards- Digital Input and Output cards, Organization of the DAQ VI system- Opto Isolation- Performing analog input and analog output- Scanning multiple analog channels- issues involved in selection of data acquisition cards- Data acquisition modules with serial communication- Design of digital voltmeter with transducer input- Timers and Counters.

COMMUNICATION NETWORKED MODULES **9 Hours**

Introduction to PC buses-Local buses:-ISA,PCI,RS232,RS422 and RS 485- Interface buses:-USB,PCMCIA,VXI,SCXI and PXI – Instrumentation Buses:- Modbus and GPIB- Networked buses-ISO/OSI reference model, Ethernet and TCP/IP Protocols.

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REAL TIME CONTROL IN VI **9 Hours**

Design of ON/OFF controller and proportional controller for a mathematically described processes using VI software- Modeling and basic control of level and Reactor Processes- Case Studies on development of HMI, SCADA in VI.

9 Hours

AUTOMOTIVE APPLICATIONS

PC based digital storage oscilloscope- Sensor technology and signal processing- virtual laboratory-spectrum analyzer- wave form generator- Data visualization and multiple locations:- Distributed monitoring and control-Vision and motion control. Case study related to automotive applications.

Theory :45 Hrs **Total Hours: 45**

References:

1. Nadovich, C., "Synthetic Instruments Concepts and Applications". Elsevier,2005
2. Bitter, R., Mohiuddin, T. and Nawricki, M., "Labview Advanced programming Techniques", CRC Press, 2nd Edition, 2007
3. Gupta, S. and Gupta J. P., "PC Interfacing for Data Acquisition and Process Control", 2nd Edition, Instrument Society of America, 1994
4. Jamal, R. and Picklik, H., "Labview-Applications and Solutions ", National Instrument Release

Other references:

1. Johnson, G.," Labview Graphical programming " , McGraw-Hill, Newyork,1997
2. Wells, L.K and Travis, J., " Labview for Everyone", Prentice Hall, New Jersey, 1997
3. Buchanan, W., "Computer Busses ", CRC Press, 2000

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U15AU*T*E17 AUTOMOTIVE HVAC

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Design and implement refrigeration and air conditioning systems using standards

CO2: Apply the concept of psychometry to estimate the heating and cooling load for automobiles

CO3: Check the operation of automatic HVAC control systems and diagnose it.

Pre-requisite:

1. Thermodynamics and Thermal Engineering

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	M		W				W			M	S	
CO2	S	M	M		W				M			M	S	
CO3	S	S	W	M	S							M	S	

Course Assessment methods:

Direct	Indirect
1. Continuous assessment tests	1. Course Exit Survey
2. Assignment	
3. End semester exam	

9 Hours

REFRIGERATION

Introduction - Methods of refrigeration - Air Refrigeration System and its applications – Vapour compression refrigeration system - Vapour absorption refrigeration system - Applications of refrigeration & air conditioning -Automobile air conditioning -Air conditioning for passengers, isolated vehicles, transport vehicles-Applications related with very low temperatures Classification, properties and selection criteria - Commonly used refrigerants – Alternative refrigerants - Eco-friendly refrigerants - Applications of refrigerants -Refrigerants used in automobile air conditioning

PSYCHOMETRY **9 Hours**

Psychometric properties, tables, charts - Psychometric processes - Comfort charts – Factor affecting comfort - Effective temperature - Ventilation requirements.

AIR CONDITIONING SYSTEMS AND LOAD ANALYSIS **9 Hours**

Classification and layouts - Central / unitary air conditioning systems - Components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems etc. Load Analysis: Outside & inside design consideration - Factors forming the load on refrigeration & air conditioning systems - Cooling & heating load calculations - Load calculations for automobiles - Effect of air conditioning load on engine performance.

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AIR DISTRIBUTION SYSTEMS **9 Hours**

Distribution duct system, sizing, supply / return ducts - Types of grills, diffusers, ventilation, air noise level - Layout of duct systems for automobiles and their impact on load calculations. Air Routine & Temperature Control: Objectives - evaporator care air flow - Through the dash re-circulating unit - Automatic temperature control - Controlling flow - Control of air handling systems.

AIR CONDITIONING SERVICE AND CONTROL **9 Hours**

Air conditioner maintenance & service - servicing heater system - Removing & replacing components - Trouble shooting of air conditioning system -Compressor service, methods of dehydration, charging & testing.

Air Conditioning Control: Common control such as thermostats- Humidistat us – Control dampers - Pressure cutouts and relays.

Theory :45 Hrs **Total Hours: 45**

References:

1. Mark Schnubel, “Automotive Heating and Air Conditioning”, Today’s Technician, 5th edn, 2013
2. Steven Daly, “Automotive Air Conditioning and Climate Control Systems”, Butterworth-Heinemann; 1 edition (2006)
3. R.J. Dossat, “Principles of Refrigeration”, Prentice Hall, 5th ed, 2001.

Other references:

1. Paul Lung, "Automotive Air Conditioning", C.B.S. Publisher & Distributor, (Delhi. 1991)

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U15AU*T*E18 MICROPROCESSOR BASED SYSTEM DESIGN

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the basics about microprocessors and its programming

CO2: Understand the microprocessor based system design

Pre-requisite:

1. Basics of Electrical and Electronics Engineering

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M												S	
CO2						S						W	S	

Course Assessment methods:

Direct	Indirect
1. Test	1. Course Exit Survey
2. Projects	

INTRODUCTION 9 Hours

Need for microprocessor based system design – Design cycle – dimensions of the design problem – Hardware design and software design – System integration.

INPUT AND OUTPUT ALGORITHMIC PROCESSES 9 Hours

I/O control – I/O timing – Data buffering with FIFOS – Keyboards and switches – Remote instrument control –Self test hardware. Keyboard parsing – Real time programming – Self test algorithm. Multiplication and division algorithms.

TROUBLESHOOTING SYSTEMS – LOGIC ANALYSERS 9 Hours

Logic state analysers, Logic timing analysers, Display modes, Logic analysers features – Signature analysis, Error detection using signature analysis. Development systems: Basic features – software development aids –Development system architecture – Emulators, system software – Assembler, linker, loader.

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8086 /8088 BASED MULTIPROCESSING SYSTEM **9 Hours**

Review of Architecture and Instruction Set of 8086 Processor Coprocessor configuration, closely coupled configurations, loosely coupled configurations – 8087 coprocessor: Architecture, Instruction set – 8089 I/O processor.

SYSTEM DESIGN APPLICATIONS **9 Hours**

LCR meter – PID controller – DC motor speed control – Digital weighing machine – Temperature control – Controller for a washing machine.

Theory :45 Hrs **Total Hours: 45**

References:

1. John B. Peatman, Microcomputer Based Interfacing, McGraw Hill, 1988.
2. Douglass V. Hall, Microprocessor and Interfacing, McGraw Hill, 1987.
3. Williams, G.B., Troubleshooting on Microprocessor Based Systems, Pergamon Press 1984.

Other references:

1. Yu-Cheng Liu and Glenn A. Gibson, Microcomputer systems, The 8086/8088 family, Second edition, Prentice Hall of India, 1990.

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U15AUTE19 TYRE TECHNOLOGY

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Basics of tyres and its Components
CO2: Understand the Types of fabrics used and their application
CO3: Understand the process of Calendering and its impact on tire properties
CO4: Understand the Thread Extrusion & Bead Construction
CO5: Understand the building & curing of tyres.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W		S				S						S	
CO2	W		S				S					M	S	
CO3	W		S			M	S					M	S	
CO4	W		S			M	S					M	S	

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment Test	1. Course Exit Survey
2. Assignments	
3. End Semester Examination	

INTRODUCTION TO BASICS OF TYRES **5 Hours**

Types of tyres, tyre components and its role, tread patterns, outline of production of tires, Requirements and function of tyres - Major departments of a Tyre Industry – An explanation of their function and relation to other departments. Factors influencing the performance of tyre: Compound design, degree of mixing: (open mill & internal mixing), parameters (temperature, time, speed), degree of vulcanization - Testing and Dispatch of mixes, Basic quality control and mill room control Laboratory.

FABRIC PREPARATION **8 Hours**

Fabrics of the Tyre Industry: Cotton, Rayon, Nylon & steel cords – manufacture, construction – styles and presentations. Bonding methods – Fabric bonding necessities of stronger fabrics leading to bonding methods developments. Wet & dry bonding systems – dip and hot stretch process for Nylon. REL-VP latex systems – and parameters for dip & hot stretch process for Nylon. Modified surface treatment needed for polyesters & glass fabric - Metal coating for steel cord. Recent developments in Radical Tyre fabrics – Aromatic Nylon (Kevlar) and other special fabric

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reinforcement systems and their use - Testing of dipped fabrics 'U', 'H' and other tests. Dip pick up and the relation to adhesion etc.

CALENDERING **8 Hours**

Calendering process: 3 and 4 roll calenders. Skimming & frictioning process preparation of bead wrapper and chaffer-on fabrics on 3 roll calenders. Topping process on calendar - Limitation of 3 roll calenders and advantages of 4 roll calenders-process control aspects – economics - Relation between ends per inch and calendering process. Inner, outer and breaker fabrics. Compound fabric ratios and compound design consideration for different styles of fabrics - Defects of calendered fabrics and their remedies. Parameters for scrap control in fabric processes in the tyre industry requirement of total quality control involving fabric supplier's dipping, calendering and bias cutting operations. Economics of fabric usage.

THREAD EXTRUSION AND BEAD CONSTRUCTION **8 Hours**

Basic concepts of Extrusion. Die swell & shrinkage phenomenon – effect of compounding parameters on this phenomenon. Die design and theoretical calculation of tread weight. Effect of viscosity & temperature on extrusion. Dimensions and weight control extrusion operation parameters like feeding rate, screw speed, take off conveyor speed on tread extrusion. Extruded tread profile – critical dimensions. Duel extruder – Cap & base concept relation to tyre wear parameters like tread wear heat buildup etc.

Cross head extruder wire coating process - Bias cutting and pocket making: Bias angle specification and the significance Horizontal and vertical laying of coated wore. Apex preparation on extruder and profile calender Bead wrapping and flipping operations. Single and double bead concept and preliminary calculation of bead safety factors. Width and angle adjustments splicing and identification. Bias plies pocket 3-3-2 4-4-2 ply constructions Defects of pockets wrong identification over splicing wrinkles, parallel plies etc.

TYRE BUILDING **8 Hours**

Tyre building inputs: Inner liners, plies, beads, tread, side wall and gum strips – their inspection Drum inspection for drum set, drum circumference Significance of parameters for tyre building. Size making on finished tyre and the relation to building specifications. Tyre building specifications sequence of building. Intermittent consolidation use of various cements and gum strips. Importance of the state of the Art Technology. Appraisal of Tyre building as most crucial operation correlation of some of the cured tyre & service returned tyres to the lack of building skill. Green tyre inspection procedures weight tolerance techno-commercial importance of green tyre weight. Green tyre storage considerations.

GREEN TYRE PREPARATION & CURING **8 Hours**

Internal and External painting – Awling – Bagging in case of Air bag cure Bag-omatic and Air bag curing – mold lubrication- Bladder assembly bead curing rings – Dimension criticality Services to the Bag-o-matic presses Curing cycle – shaping – HPS, and hot water circulation. Dome steam cold water & vacuum cycles. Determination of optimum cure of tyres by thermocouple built tyres. Economics of curing post cure inflation of Nylon tyres cured tyre inspection. Defects of tyres – Tyre classification for defects – causes and discussions - Examination of: (i) Returned tyres (ii) Tyres for retreading - Norm of tyre adjustments for fastwear, poor retreading Bead/casing failures. Hot and cold process retreading concept of total price/km run increasing competition and future trends in the industry and open house discussion.

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Theory :45 Hrs **Total Hours: 45**

References:

1. Tom French, Tyre technology, The University of Michigan, 1989.
2. Blow. C. M, Rubber Technology and Manufacture, Butterworth- Heinemann, London, 1982.
3. Maurice Morton, “Rubber Technology”, Springer, 3rd edition, 1987.
4. Claude Hepburn, “Rubber Technology and Manufacture”, Third Edition, 2005.

Other references:

1. Kovac. F. J, “Tyre Technology”, Good Year Tire & Rubber Company, 1973.
2. Different tyre manufacturer’s websites.

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U15AU*T*E20 VEHICLE TESTING AND VALIDATION

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the concept of vehicle and engine performance evaluation

CO2: Understand about the Laboratory and On road testing of vehicles

CO3: Understand the various mechanical measurement devices used in vehicle testing

Pre-requisite:

1. Measurements & Metrology

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S	S	S	M							M	S
CO2	S		S	S	S	M							M	S
CO3	S		S	S	S	M							M	S

Course Assessment methods:

Direct	Indirect
1. Assignments	1. Course Exit Survey
2. Continuous assessment tests	
3. End-semester examination	

MEASUREMENT SYSTEMS **9 Hours**

Introduction to Measurement systems-static and dynamic measurement –closed and open loop system - Requirements and characteristics – Analysis of experimental detail. Error analysis

TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES **9 Hours**

Transducers for Automotive Applications – Amplifiers- filters –data Acquisition- Indicators, Printers and displays –Signal Analyzing

MECHANICAL MEASUREMENT **9 Hours**

Instrumentation for measuring Weight, Force, torque, pressure power, temperature, fluid flow, vibration, rotational speed, velocity, acceleration and angular motion

ENGINE EXPERIMENTAL TECHNIQUES **9 Hours**

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

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VEHICLE EXPERIMENTAL TECHNIQUES **9 Hours**

Laboratory tests- test tracks - Endurance Tests- crash tests- Vehicle performance test – Brake tests.

Theory :45 Hrs **Total Hours: 45**

References:

1. A.W. JUDGE, Engineering Precision Measurement, Chapman and Hall Ltd, Essex Street W.C.,1951,
2. T.G. Beckwith and Buck, Mechanical Measurements, Oxford and IBH Publishing House, New Delhi, 1995
3. D.Patambis, Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co, New Delhi, 1990.
4. Rangan, Sharma and Mani, Instrumentation Devices and systems, Tata McGraw Hill Publishing Co., Ltd., 1990

Other references:

1. J.G. Giles, Engine and Vehicle Testing, Illiffe books Ltd., London,1968.

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U15AU*T*E21 **VEHICLE TROUBLESHOOTING AND MAINTENANCE**

L	T	P	c
3	0	0	3

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Become familiar with Need for Vehicle Maintenance
CO2: Apply the concepts of scheduling
CO3: Trouble shoot and Repair

Pre-requisite:

1. Automotive Chassis
2. Automotive Transmission

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			S		M				M			M		S
CO2	M			M							S			S
CO3			S		M	S	M							S

Course Assessment methods:

Direct	Indirect
1.Continuous assessment tests	1. Course Exit Survey
2.Assignment	
3. End semester exam	

MAINTENANCE OF RECORDS AND SCHEDULES **9 Hours**

Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance. service schedule (Manufacture Km service) and service history maintenance

ENGINE MAINTENANCE REPAIR AND OVERHAULING **9 Hours**

Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up.- Need for overhauling- Preparation of Cost sheets (estimation)- Engine performance analysis-Troubleshoot and Remedies

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CHASSIS MAINTENANCE REPAIR AND OVERHAULING 9 Hours

Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft and differential system. Maintenance servicing of suspension systems. Brake systems, types and servicing techniques. Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing. How to diagnose troubles and Remedies.- Road Test

ELECTRICAL SYSTEM MAINTENANCE SERVICING AND REPAIRS 9 Hours

Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instrument- Diagnose troubles and Remedies

MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VECHICLE BODY 9 Hours

Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance. Manufacture recommended fluids- Kaizen method on schedule services, how to increase productivity and efficiency- Case studies. Field surveys.- Latest technologies in servicing

Theory :45 Hrs **Total Hours: 45**

References:

1. John Doke, "Fleet management ", McGraw Hill Co, 1984.
2. James D Halderman - Advanced Engine Performance Diagnosis PHI - 1998.
3. Judge A N, “Motor vehicle engine servicing, 3rd, Edition ", Pitman Paper pack, London, 1969.

Other references:

1. Service Manuals from Different Vehicle Manufacturers.

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U15AUT*E*22

MEASUREMENTS AND METROLOGY

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify the basic measurement tools

CO2: Apply the concept of measurements in inspecting various parameters.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					M				M	M		M		M
CO2	M				M				M	M		M		

Course Assessment methods:

Direct	Indirect
1. Continuous assessment tests	1. Course Exit Survey
2. Assignments	
3. End-semester Examinations	

INTRODUCTION TO METROLOGY — 9 Hours

Units and standards, terminology and measurement errors. Linear measuring instruments, dial gauges, comparators and linear measuring machines. Angular measuring instruments- measurement of straightness flatness and surface finish. Profilographs.

MEASUREMENTS OF SCREW THREAD – GEAR ELEMENTS – SURFACE FINISH — 9 Hours

Internal and External screw threads: Measurements of various elements of thread – Best size wire – Two and three wire method. Gear: Measurements of various elements – Constant chord method – Base tangent method. Surface Finish: Surface topography definitions – Measurement of Surface Texture – Methods –Evaluation of Surface finish.

PRESSURE AND FLOW MEASUREMENT — 9 Hours

Bourden tube, diaphragm, bellows and pressure capsules: Transducers used in pressure measurement- potentiometer, strain gauges, LVDT, capacitive and variable reluctance type transducers.

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Obstruction type flow meter-, flow nozzles, pitot tube, Positive displacement flow meters – turbine flow meter, flouted tube flow meter, anemometer, ultrasonic flow meter, magnetic flow meters.

TEMPERATURE MEASUREMENT **9 Hours**

Temperature scales – mechanical temperature sensors, liquid in glass, vapour pressure, bimetal temperature gauges. Resistance type temperature sensors. Thermistors, thermocouples, Laws of thermocouple, types of thermocouples. Construction and circuits for thermocouples. High temperature measurement pyrometers.

FORCE AND TORQUE MEASUREMENT **9 Hours**

Force measuring devices- weigh bridges, load cells, proving ring. Torque measurement – prony brake, rope brake and fan type brakes. Dynamometers – hydraulic, electric cradle and eddy current dynamometers. Transmission dynamometers. Chassis dynamometers.

Theory :45 Hrs **Total Hours: 45**

References:

1. Jain R.K., "Engineering Metrology", Khanna publishers, New Delhi, 2005.
2. Rangan C.S., Sarma G.E and Mani V.S "Instrumentation devices and systems". TMH Publishing Co. New Delhi, 2001.
3. Beckwith T.G & Buck N.L "Mechanical Measurements", Oxford and IBH publishing house New Delhi, 2004.
4. Patranabis D, "Principles of industrial instrumentation", TMH Publishing Co. New Delhi, 2000.
5. A. K. Sawhney, 'A Course in Electrical and Electronics Measurement and Instrumentation' Dhanpat Rai, 1994

Other references:

1. Jain R.K., "Mechanical & Industrial Measurements" , Khanna publishers, New Delhi, 2005.
2. Doeblin,"Measurement System Application &Design" McGraw Hill ,New Delhi, 2004.
3. Gaylor F.W and Shotbolt C.R "Metrology for Engineers", ELBS, 2006.

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U15AUT*E*23 SPECIAL PURPOSE VEHICLES

L	T	P	C
3	0	0	3

Course Outcomes(COs)

After successful completion of this course, the students should be able to:

CO1: Understand special type of vehicles based on the need and purpose.
CO2: Understand the working of power take off shaft
CO3: Understand various types of wheels for off road vehicles

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					W			W	M		W	M	M
CO2	M					W			W	W		W	M	M
CO3	M					W			W	M		W	M	M

Course Assessment methods:

Direct	Indirect
1. Assignment	
2. Internal test	
3. End Semester Examination	

CLASSIFICATION AND REQUIREMENTS OF OFF ROAD VEHICLES — 6 Hours

Construction layout, capacity and applications. Power Plants, Chassis and Transmission, Multiaxle vehicles.

EARTH MOVING MACHINES — 10 Hours

Earthmovers like dumpers, loaders - single bucket, Multi bucket and rotary types - bulldozers, excavators, backhoe loaders, scrappers, drag and self powered types, Bush cutters, stumpers, tree dozer, rippers etc. – Power and capacity of earth moving machines.

SCRAPPERS ,GRADERS, SHOVELS AND DITCHERS — 10 Hours

Scrappers, elevating graders, motor graders, self powered scrappers and graders, Power shovel, revolving and stripper shovels – drag lines – ditchers – capacity of shovels.

FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES — 8 Hours

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Power take off, special implements. Special features and constructional details of tankers, gun carriers and transport vehicles.

VEHICLE SYSTEMS ,FEATURES **11 Hours**

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

Theory :45 Hr **Total Hours: 45**

References:

1. Robert L Peurifoy, "Construction, planning, equipment and methods" Tata McGrawel Hill Publishing company Ltd.
2. Nakra C.P., "Farm machines and equipments" Dhanparai Publishing company Pvt. Ltd
3. Abrosimov.K. Bran berg.A and Katayer.K., Road making machinery, MIR Publishers, Moscow, 1971
4. Satyanarayana. B., Construction planning and equipment, standard publishers and distributors, New Delhi.

Other references:

1. SAE Handboob Vol. III. Wong.J.T., Theory of Ground Vehicles", John Wiley & Sons, New York, 1987.
2. Off the road wheeled and combined traction devices – Ashgate Publishing Co. Ltd. 1988.
3. Schulz Erich.J, Diesel equipment I & II, Mcgraw Hill company, London.
4. Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co Ltd., London.

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U15AU*T*E24

ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Analyze himself on entrepreneurial traits
CO2: Analyze various business opportunities
CO3: Prepare a project report on a project idea

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						S	S	S	S		S	S		S
CO2						S	S	S	S		S	S		S
CO3						S	S	S	S		S	S		S

Course Assessment methods:

Direct	Indirect
1. Continuous assessment tests	1. Course Exit Survey
2. Assignment	
3. End semester exam	

ENTREPRENEURSHIP — 9 Hours

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur, Multiprener, Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth

MOTIVATION — 9 Hours

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

BUSINESS — 9 Hours

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – e-business –Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies

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FINANCING AND ACCOUNTING **9 Hours**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax

SUPPORT TO ENTREPRENEURS **9 Hours**

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting

Theory :45 Hrs **Total Hours: 45**

References:

1. Khanka. S.S, "Entrepreneurial Development" S.Chand& Co. Ltd., Ram Nagar, New Delhi,2013.
2. Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014.
3. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013
4. Mathew J Manimala, Enterprenuership theory at cross roads: paradigms and praxis", 2nd Edition, Dream tech, 2005

Other references:

1. Rajeev Roy, 'Entrepreneurship', 2nd Edition, Oxford University Press, 2011
2. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986

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U15AU*T*E25 PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the concepts of project definition, life cycle, and systems approach

CO2: Develop competency in project planning, scheduling and related activities.

CO3: Handle the complex tasks of time estimation and project scheduling, including PERT and CPM.

CO4: Develop competencies in project Costing, budgeting, and financial appraisal

CO5: Gain exposure to project control and management, using standard tools of Cost and schedule variance analysis.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M	M	S	S	S	S	M		M
CO2						M	M	S	S	S	S	M		M
CO3						M	M	S	S	S	S	M		M
CO4						M	M	S	S	S	S	M		M
CO5						M	M	S	S	S	S	M		M

Course Assessment methods:

Direct	Indirect
1. Assignment /Case Study	1. Course Exit Survey
2. Internal Examination	
3. End Semester Examination	

PROJECT MANAGEMENT CONCEPTS **9 Hours**

Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals. Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity. Organizing human resources, organizing systems & procedures for implementation. Project direction.

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PROJECT ORGANIZATION & PROJECT CONTRACTS **9 Hours**

Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

PROJECT APPRAISAL & COST ESTIMATION **9 Hours**

Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social Cost/benefit analysis, project risk analysis. Cost analysis of the project, components of capital Cost of a project, modern approach to project performance analysis

PROJECT PLANNING & SCHEDULING **9 Hours**

Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model, expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM Cost accounting systems, lowest Cost schedule, crashing of networks, linear programming formulation of event oriented networks, updating of networks, LOB technique

MODIFICATION & EXTENSIONS OF NETWORK MODELS **9 Hours**

Complexity of project scheduling with limited resources, resource leveling of project schedules, resource allocation in project scheduling - heuristic solution. Precedence networking- examples with algorithm, decision networks, probabilistic networks, computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections.

Theory :45 Hrs **Total Hours: 45**

References:

1. Nagarajan. K, “Project “Management, New Age International, 2012.
2. Harvey Maylor, “Project Management”, Prentice Hall, 2010.

Other references:

1. Erik W. Larson, “Project Management”: The Managerial Process (Special Indian Edition), Tata McGraw-Hill Education, 2006

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U15AU*T*E26

QUALITY CONTROL AND RELIABILITY

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand statistical quality control techniques
CO2: Predict the life of components based on their reliability
CO3: Analyze the failure data using various methods

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		W								S	M		M
CO2	S		W								S	M		M
CO3	M		W								S	M		M

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Internal Test	
3. End Semester Examination	

STATISTICAL PROCESS CONTROL **9 Hours**

Quality control – Definition – Quality Assurance Variation in process – Factors – control charts – variables XR and XÃ, - Attributes P, C and U-Chart Establishing and interpreting control charts process capability – Quality rating – Short run SPC.

ACCEPTANCE SAMPLING **9 Hours**

Lot by lot sampling types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts Design of single sampling plan – standard sampling plans for AQL and LTPD – Use of standard sampling plans – Sequential sampling plan

EXPERIMENTAL DESIGN & TAGUCHI METHOD **9 Hours**

Fundamentals – factorial experiments – meantime to failure – maintainability and availability – reliability – system reliability – OC curves – reliability improvement techniques – Reliability testing techniques – Pareto analysis

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RELAIBILITY AND ITS PREDICTION **9 Hours**

Life testing – Failure characteristics – MTBA MTTF – System reliability – OC curve Availability and Maintainability – Reliability Improvement techniques

FAILURE DATA ANALYSIS **9 Hours**

Real time distribution, exponential, normal, log normal, gamma and weibull – reliability data requirements – Graphical evaluation

Theory :45 Hrs **Total Hours: 45**

References:

1. AmitaMitra "Fundamentals of Quality Control and Improvement" Pearson Education, 2002
2. Modares: Reliability & Risk Analysis Marcel Decker Inc. 1993.
3. Bester field D.H., "Quality Control" Prentice Hall, 7th edition 2003

Other references:

1. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publications, 2004

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U15AU*T*E27

MODERN AUTOMOBILE ACCESSORIES

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Engine & Chassis Management system
CO2: Understand the Heating and Air-Conditioning
CO3: Understand the Comfort , Convenience, Safety & Security Systems

Pre-requisite:

1. Automotive Chassis
2. Automotive Engine Systems

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W	S				S						M	M	
CO2	W	S				S						M	M	
CO3	W	S				S						M	S	

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment Test	1. Course Exit Survey
2. Assignments	
3. End Semester Examination	

ENGINE MANAGEMENT SYSTEMS **9 Hours**

Electronically controlled SI and CI engine fuel injection systems, related hardware and software. Closed loop ignition system. Catalytic converters and particulate traps.

CHASSIS **9 Hours**

Active suspension control, Pneumatic suspensions, Power train monitoring, safety views-Modern development in Chassis management of vehicles.

HEATING AND AIR CONDITIONING **9 Hours**

Principles of vehicle air conditioning and heating-Automatic climate control system-Modern trends in thermal management of vehicles-Influence of Electronics in thermal management of vehicles.

COMFORT AND CONVENIENCE **9 Hours**

Adaptive cruise control, car entertainment, power windows, navigation system, adaptive noise control, electric seats, driver information system. Power windows, power steering.

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SAFETY AND SECURITY SYSTEMS **9 Hours**

Airbags, seat belt tightening system, collapsible and tiltable steering column, Anti-theft system, anti-lock braking system, electronic stability control system/traction control system, roll over protection system.

Theory :45 Hr **Total Hours: 45**

References:

1. Tom Denton - "Automobile Electrical and Electronic Systems" - Edward Arnold, London - 1995.
2. Eric Chowanietz - 'Automotive Electronics' - SAE International USA - 1995.

Other references:

1. Bosch Automotive Hand Book - 5th Edition - SAE Publication, USA - 2000.

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U15AUT*E*28 AUTOMOTIVE SYSTEMS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Apply the concept of embedded systems in the automobile applications.

CO2: Outline the stability and safety systems used in automobiles.

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M				M								S	
CO2				S		M			S			M	M	

Course Assessment methods:

Direct	Indirect
1. Tests	1. Course Exit Survey
2. Lab Experiments	
3. Projects	

EMBEDDED CONTROL SYSTEMS **9 Hours**

Introduction to Embedded control systems, Microcontroller and processors used in Automotive systems, need for electronics in automobiles, Engine control unit, Electronic– Input devices- Sensors- wheel speed sensor, Crash sensor etc.

ELECTRONIC FUEL INJECTION & IGNITION SYSTEM **9 Hours**

Introduction, feedback carburettor system, throttle body injection, advanced GDI and multi point fuel injection system, injection system controls, advantage of electronic ignition systems, types of solid state ignition system and their principles of operation, electronic spark timing control.

BRAKING AND ELECTRONIC STABILITY CONTROL **9 Hours**

Vehicle motion control, collision avoidance control – cruise control, Adaptive cruise control, Electronic transmission control. Vehicle stabilization system -Antilock braking system, Traction control system, Anti slip regulation, Electronic stability program. On-board diagnosis system.

PASSIVE SAFETY SYSTEMS **9 Hours**

Air bags and seat belt pretensioner systems: Sensor functions, Distributed front air bag sensing systems, Single-point sensing systems, Side-impact sensing – driver monitoring systems.

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INFOTAINMENT SYSTEMS **9 Hours**

Global positioning systems, geographical information systems, navigation systems,Voice Command Systems, automotive vision system, lane departure warning system, driver assistance systems such as power seats, Power windows, and Remote keyless entry systems.

Theory :45 Hrs **Total Hours: 45**

References:

1. Automotive Computer Controlled Systems Diagnostic tools and techniques-Allan W. M. Bonnick, Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP
2. Electronic Engine Control Technologies, 2nd Edition-Ronald K. Jurgen-SAE International
3. Ljubo Vlacic, Michel Parent & Furnio Harshima, "Intelligent Vehicle Technologies: Theory and Applications", Butterworth-Heinemann publications, 2001
4. Denton. (2004) Automotive Electrical and Electronic Systems, Burlington, MA 01803, Elsevier Butterworth-Heinemann.

Other references:

1. Ronald K. Jurgen. (1999) Automotive Electronics Handbook, McGraw-Hill Inc.,
2. Bosch. (1999) Automotive Electrics & Electronics, Robert Bosch GmbH, 3rd edition.
3. Telematics Communication Technologies and Vehicular Networks: Wireless Architectures and Applications-Chung-Ming Huang, National Cheng Kung University, Taiwan; Yuh-Shyan Chen, National Taipei University, Taiwan

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U15AU*T*E29 AUTOMOTIVE SAFETY

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand and remember the fundamentals of safety during body design

CO2: Applying the knowledge for selecting the suitable active & passive systems

CO3: Applying the knowledge for selecting the suitable safety equipments for designing a vehicle

CO4: Creating the advanced system for increasing the safety in special purpose vehicles

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		M			M							S	M
CO2	M					M							S	M
CO3						M							S	
CO4			S										S	W

Course Assessment methods:

Direct	Indirect
1. Continuous assessment tests	1. Course Exit Survey
2. Presentation	
3. End-semester examinations	

INTRODUCTION 9 Hours

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

SAFETY CONCEPTS 9 Hours

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

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SAFETY EQUIPMENTS **9 Hours**

Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

COLLISION WARNING AND AVOIDANCE **9 Hours**

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

COMFORT AND CONVENIENCE SYSTEM **9 Hours**

Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system

Theory :45 Hrs **Total Hours: 45**

References:

1. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000.
2. Vivek D. "*Ergonomics in the Automotive Design Process"* Bhise publisher CRC press, Taylor and Francis group.
3. Ronald K Jurgen, "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999.
4. Jullian Happian, "Smith An Introduction to Modern Vehicle Design", SAE, 2002.

Other references:

1. Johnson W and Mamalis A.G, "Crashworthiness of Vehicles", MEP, London.
2. Richard Bishop, "Intelligent Vehicle Technology and Trends" – 2005.
3. George A. Peters , Barbara J. Peters, "Automotive Vehicle Safety" – 2002.

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U15AUT*E*30

AUTOMOTIVE POLLUTION AND CONTROL

L	T	P	C
3	0	0	3

Course Outcomes(COs)

After successful completion of this course, the students should be able to:

CO1: Familiarize the norms of pollution standards

CO2: Analyze the sources of pollution from automobiles

CO3: Understand the pollution control methods and apply.

Pre-requisite:

1. Environmental Science and Engineering

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						S	S					M	S	
CO2	M		W			M	M					M	S	
CO3	M		W			M	M					M	S	

Course Assessment methods:

Direct	Indirect
1. Assignments	
2. Continuous assessment tests	
3. End-semester examination	

INTRODUCTION **6 Hours**

Pollutants – sources – formation – effects of pollution on environment - human – transient operational effects on pollution – Regulated – Unregulated emissions - Emission Standards- Euro, Bharat Stage & Legislative Norms.

POLLUTANT FORMATION IN SI ENGINES **9 Hours**

Chemistry of SI engine combustion – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating variables on emission formation.

POLLUTANT FORMATION IN CI ENGINES **10 Hours**

Basics of diesel combustion – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines – Particulate emission in diesel engines. Odor, sulfur and Aldehyde emissions from diesel engines – effect of operating variables on emission formation.

CONTROL OF EMISSIONS FROM SI AND CI ENGINES **10 Hours**

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Design modifications – Optimization of operating factors – Fuel modification – Evaporative emission control - Exhaust gas recirculation – SCR – Fumigation – Secondary Air injection – PCV system – Particulate Trap – CCS – Exhaust treatment in SI engines –Thermal reactors – Catalytic converters – Catalysts – Use of unleaded petrol.

MEASUREMENT TECHNIQUES EMISSION STANDARDS AND TEST PROCEDURE **10 Hours**

Test procedures CVS1, CVS3 – Test cycles – IDC – ECE Test cycle – FTP Test cycle – NDIR analyzer – Flame ionization detectors – Chemiluminescent analyzer – Dilution tunnel – Gas chromatograph – Smoke meters –SHED test.

Theory :45 Hrs **Total Hours: 45**

References:

1. Paul Degobert – Automobiles and Pollution – SAE International ISBN-156091-563-3, 1991.
2. B.P.Pundir, " IC Engines Combustion and Emissions" Narosa Publishers, 2010
3. Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2003.
4. John. B, Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., New York, 1990 .
5. Robert Bosch, "Emissions-Control Technology for Diesel Engines", BENTLEY ROBERT Incorporated, 2005

Other references:

1. Springer and Patterson, Engine Emission, Plenum Press, 1990.
2. SAE Transactions- "Vehicle Emission"- 1982 (3 volumes).
3. Obert.E.F.- "Internal Combustion Engines"- 1988
4. Marco Nute- " Emissions from two stroke engines, SAE Publication – 1998

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U15AUT*E*31 INTELLECTUAL PROPERTY RIGHTS, INNOVATION AND TECHNOLOGY

L	T	P	C
3	0	0	3

Course Outcomes(COs)

After successful completion of this course, the students should be able to:

CO1: Understanding major issues in economics of IP rights, technology and innovation

CO2: Enhance capability to do economic analysis of IP rights, technology and innovation related policy issues and firms' commercial strategies.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						S	S							M
CO2	M		W			M	M							

Course Assessment methods:

Direct	Indirect
1. Assignments	
2. Continuous assessment tests	
3. End-semester examination	

INTRODUCTION **9 Hours**

Background and Concepts - Brief History of - Institutions - Investing in Knowledge - Market Failures in Knowledge - IP, Public Sponsorship & Prize - IP Law Basics - Means of IP Protection - Patents - Copyrights - Trade Secrets - Others - IP and Antitrust

THE IMPACTS OF IP ON THE PLANT/SEED INDUSTRY **9 Hours**

The logic of IP - Patenting vs. Company Secrets - Plant Patent Timeline - Empirical Evidence in Plants: A Puzzle - Optimal Design of IP - Scarce Ideas vs. Non-scarce ideas - Policy Levers in IP Design - Breadth - Length - Required - Inventive Steps - Optimal Size of Reward and Structure - Entry Cost Regime - Horizontal Competition Regime - Economic Effects of Exemptions

PROTECTING CUMULATIVE INNOVATIONS **9 Hours**

Three Types of Cumulativeness - Basic v. Applied Research - Research Tool - Quality Ladders - Policy Levers and Prospecting - Open Source (OS) – Incentive for OS - Licensing, Joint Ventures and Competition Policy - Licensing – Licensing vs. Product Sale - Licensing for Productive Efficiency - New Product Innovation vs. Cost Reduction Innovation - Mergers - Competition Policy in the Innovation Context

LITIGATION AND ENFORCEMENT **9 Hours**

Litigation and Enforcement - Remedies for Infringement - How they matter - Enforcement of IP by Technical Means - Limited Sharing of Copyrighted Works - Technology Transfer, Diffusion, and

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Adoption - Networks and Network Effects - Concepts and Issues - Direct vs. Indirect Network Effects - Physical Networks - Business Strategies - System Competition vs. Standard Competition

INNOVATION TODAY **9 Hours**

A Private-Public Partnership - University Innovation - Government Grant Process - Mixed Private-Public Incentives - Innovation in the Global Economy – Who Patents and Where - Trade Policy and Treaties - Paris Convention, Berne Convention, TRIPS - PCT and WIPO - National Treatment and Efficient Protection - Harmonization - Externalities and International Cooperation

Theory :45 Hrs **Total Hours: 45**

References:

1. Christopher May, Susan K. Sell, "*Intellectual Property Rights",* Lynne Rienner Publishers
2. Hideyasu Sasaki, "*Intellectual Property Protection for Multimedia Technology",* Information Science Publishing

Other references:

1. Subbaram.N.R. "*Handbook of Indian Patent Law and Practice*", S. Viswanathan Printers and Publishers Pvt. Ltd., 1998.
2. N.S. Gopalakrishnan & T.G. Agitha, "*Principles of Intellectual Property (2009)",* Eastern Book Company, Lucknow

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U15AU*T*E32

VEHICLE TRANSPORT MANAGEMENT

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the concept of personal Management and selection process
CO2: Understand the Passenger and Good Transport management Systems
CO3: Understand the Motor Vehicle Act
CO4: Understand the Automobile vehicle Maintenance.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			S			S		S	S	S	S	M		S
CO2			S			S		S	S		S	M		S
CO3			S			S		S			S			S
CO4			S			S		S			S	M		S

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment Test	1. Course Exit Survey
2. Assignments	
3. End Semester Examination	

INTRODUCTION **9 Hours**

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

PASSENGERTRANSPORTOPERATION **9 Hours**

Structure of passenger transport organizations- Typical depot layouts- Requirements and Problems on fleet management- Fleet maintenance- Planning -Scheduling operation & control- Personal & training-training for drivers & conductors- Public relations, Propaganda, publicity and passenger amenities-

Parcel traffic.- Theory of fares-Basic principles of fare charging- Differential rates for different types of services- Depreciation & debt charges- Operation Cost and Revenues- Economics & records

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GOODS TRANSPORT OPERATION **9 Hours**

Structure of goods transport organizations- Scheduling of goods transport- Management Information System (MIS) in passenger / goods transport operation- Storage & transportation of petroleum products- Advance Techniques in Traffic Management- Traffic navigation- Global positioning system.

MOTOR VEHICLE ACT **9 Hours**

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

MAINTENANCE **9 Hours**

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

Theory :45 Hrs **Total Hours: 45**

References:

1. John Duke - Fleet Management – McGraw-Hill Co, USA -1984.
2. Government Motor Vehicle Act – Eastern Book Company, Lucknow – 1989
3. Kitchin.L.D., - Bus Operation - Illiffee and Sons Co., London, III edition – 1992

Other references:

1. The motor vehicle Act 1939 - Ejaz Ahemad, Ashok law house, India - 1989.

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U15AU*T*E33

HYBRID, ELECTRIC AND FUEL-CELLVEHICLES

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Differentiate electric and hybrid vehicles

CO2: Understand the subsystems and components used in electric and hybrid vehicles

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M												M	
CO2	M											S	M	

Course Assessment methods:

Direct	Indirect
1. Internal Test	1. Course Exit Survey
2. End semester Examination	

INTRODUCTION TO ELECTRIC VEHICLES **9 Hours**

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

HYBRID VEHICLES **8 Hours**

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

ELECTRIC PROPULSION SYSTEMS, GENERATORS, MOTOR CONTROLLERS AND CONTROL SYSTEMS **10 Hours**

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

DC generators, AC generators, voltage and frequency regulations.

Control system principles, speed and torque control – DC motors and AC motors.

ENERGY STORAGES **9 Hours**

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Electromechanical batteries- types of batteries –lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultracapacitors.

FUEL CELLS & SOLAR CARS **9 Hours**

Fuel cell, construction, working, equations, possible fuel sources, fuel reformer, design. Solar cars- photovoltaic cells, tracking, efficiency and Cost comparison

Theory :45 Hrs **Total Hours: 45**

References:

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

Other references:

1. Ron Hodkinson and John Fenton, “Light Weight Electric/Hybrid Vehicle Design”, Butterworth-Heinemann, 2001.

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U15AU*T*E34 FUEL CELL TECHNOLOGY

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the concept of fuel cells in automobiles

CO2: Understand the various characteristic components of fuel cell

CO3: Analyze the Performance of fuel cell in automobile application.

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													M
CO2		S	S											M
CO3	M	S												

Course Assessment methods:

Direct	Indirect
1. Continuous assessment tests	1. Course Exit Survey
2. Assignment	
3. End-semester examinations	

INTRODUCTION TO FUEL CELLS **9 Hours**

Introduction – working and types of fuel cell – low, medium and high temperature fuel cell, liquid and methanol types, proton exchange membrane fuel cell solid oxide, hydrogen fuel cells – thermodynamics and electrochemical kinetics of fuel cells.

FUEL CELLS FOR AUTOMOTIVE APPLICATIONS **9 Hours**

Fuel cells for automotive applications – technology advances in fuel cell vehicle systems – onboard hydrogen storage – liquid hydrogen and compressed hydrogen – metal hydrides, fuel cell control system – alkaline fuel cell – road map to market.

FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE **9 Hours**

Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, ohmic resistance, kinetic performance, mass transfer effects – membrane electrode assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates.

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FUELING 9 Hours

Hydrogen storage technology – pressure cylinders, liquid hydrogen, metal hydrides, carbon fibers – reformer technology – steam reforming, partial oxidation, auto thermal reforming – CO removal, fuel cell technology based on removal like bio-mass.

FUEL CYCLE ANALYSIS 9 Hours

Introduction to fuel cycle analysis – application to fuel cell and other competing technologies like battery powered vehicles, SI engine fueled by natural gas and hydrogen and hybrid electric vehicle.

Theory :45 Hrs **Total Hours: 45**

References:

1. Fuel Cells for automotive applications – professional engineering publishing UK. ISBN 1-86058 4233, 2004.

Other references:

1. Fuel Cell Technology Handbook SAE International Gregor Hoogers CRC Press ISBN 0-8493-0877-1-2003.

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U15AU*T*E35 PRODUCT ENGINEERING

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the basics of Project management
CO2: Understand the basics of Conceptual design
CO3 Understand the Component design and documentation
CO4: Understand the Actual product design
CO5: Understand the Actual product Prototyping, testing and trials

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			S			S		S	S	S	S	M		S
CO2			S			S		S	S	S	S	M		S
CO3			S			S		S	S	S	S	M		S
CO4			S			S		S	S	S	S	M		S
CO5			S			S		S	S	S	S	M		S

Course Assessment methods:

Direct	Indirect
1. Continuous assessment tests 2. Assignment 3. End-semester examinations	1. Course Exit Survey

PROJECT MANAGEMENT **9 Hours**

Introduction to Project Management (PM), Collaborative Working, PM Tutorials and their implementation for the same in their projects in tools such as Microsoft Projects.

Ideation & conceptual Design **9 Hours**

Elements of design; Product development cycle overview; Market demands and trends for products; Product Lifecycle Management (PLM) overview; Ideation and conceptual design phase introduction; Benefits and use cases of ideation and conceptual design, Capturing Voice of the customer (VOC), Use of Trizz in ideation.

Product Engineering – Component Design **9 Hours**

Product Design Phase – I: The evolution of CAD: Benefits of Digital Prototyping Design: General 3D Design Concepts. Product Design

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Phase–Part 2; Design for manufacturing, introduction; Design styled components. Product Design Phase – Part 3; Top Down and Bottom Up Design Methods; Manufacturing and Engineering Bill of Materials (BOMs); Team and Collaborative based Design.

Product Engineering – Documentation (Drawings) **9 Hours**

Design Documentation Requirements; Importance and benefits of design documentation; When do you need documentation and when do you not; Drawings requirements (Detailed drawings & Assembly Drawings), Design changes and Automation & Visualization Extending Design Data.

Prototyping, Testing & User Trials **9 Hours**

Need - Development of RP systems, RPT Technologies, Rapid Tooling & Case Studies.

Theory :45 Hrs **Total Hours: 45**

References:

1. Joseph E. Shigley& Larry D. Mitchell, "Mechanical Engineering Design", Fourth Edition, McGraw-Hill International Book Company.
2. Machine Design - An Integrated Approach -- Robert L. Norton – Pearson Education.
3. Mastering Autodesk Inventor by Sybex
4. Autodesk Inventor 2012 for Designers by CADCIM Technologies
5. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
6. Rapid Prototyping and Engineering applications : A tool box for prototype development, LiouW.Liou, Frank W.Liou, CRC Press, 2007.

Other references:

1. Rapid Prototyping: Theory and practice, Ali K. Kamrani, EmadAbouel Nasr, Springer, 2006
2. Engineering Design and Design for Manufacturing by Dixen& Poly, University of Mas. Press

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U15AU*T*E36 **FUELS AND LUBRICANTS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the refining process of petroleum
CO2: Understand the various types of fuels and their properties
CO3: Apply the knowledge in testing the fuel properties
CO4: Understand the properties and purpose of lubricants.
CO5: Understand the Alternate fuels available

Pre-requisite:

1. Engineering Chemistry, Thermodynamics and Thermal Engineering

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	W			M	M					M	M	
CO2	W	M	W			M	M					M	M	
CO3	M	M	W			M	M					M	M	
CO4	M	W	W			W	W					M	M	
CO5		M				W	W					M		

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course Exit Survey
2. Internal test	
3. End semester examination	

MANUFACTURE OF FUELS AND LUBRICANTS **9 Hours**

Fuels, Structure of petroleum, refining process, thermal and catalytic cracking, products of refining process, manufacture of lubricating oil base stocks and finished automotive lubricants.

FUELS FOR I.C. ENGINES **9 Hours**

Types of Fuels, Liquid and gaseous fuels, heating value of fuels, higher and lower heating values, chemical structure of hydro-carbons SI Engine fuels, Volatility characteristics, desirable characteristics of SI Engine fuels, knock rating and additives.

COMBUSTION OF FUELS **9 Hours**

Stoichiometry - calculation of theoretically correct air required for combustion of liquid and gaseous fuels, volumetric and gravimetric analysis of the dry products of combustion, mass of dry gas per

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kg of fuel burnt, mass of carbon in the exhaust gas, mass of carbon burnt to carbon-monoxide per kg of fuel, heat loss due to incomplete combustion, exhaust gas analysis by Orsat apparatus.

LUBRICANTS 9 Hours

Theory of Lubrication, Effect of engine variables on friction, Types of Lubrications-Hydrodynamic and Hydrostatic lubrication. Requirements for automotive lubricants and types, oxidation deterioration and degradation of lubricants, additives of lubricants and synthetic lubricants, classification of lubricating oils, tests on lubricants. Grease, classification, properties, testing of grease.

ALTERNATE FUELS 9 Hours

Alternate fuels for SI engines and CI engines, desirable characteristics, Octane and cetane rating, biodiesel. Introduction to electric, hybrid and fuel cell vehicles.

Theory :45 Hrs **Total Hours: 45**

References:

1. V.Ganesan, "Internal Combustion Engines" Tata McGraw-Hill Publishing Co. New delhi, 1999
2. M.L.Mathur and P.Sharma "A Course in internal combustion engines", Dhanpatrai Publications,2012

Other references:

1. Francis, W – Fuels and Fuel Technology, Vol. I & II,1980
2. A.R.Lansdown – Lubrication – A practical guide to lubricant selection – Pergamon press – 1982.
3. Raymond.C.Gunther – Lubrication – Chilton Book Co., - 1971.

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U15AU*T*E37 **ENGINEERING SYSTEM ANALYSIS**

L	T	P	C
2	0	1	3

Course Objectives

To impart the knowledge in measuring various parameters by using various test methods for the vehicles.

Course Outcomes(COs)

After successful completion of this course, the students should be able to:

CO1: Evaluate and apply engineering knowledge including data acquisition/analysis to components and systems used in engineering machinery and transport systems.

CO2: Create and evaluate designs and solutions for engineering systems.

CO3: Develop, apply, and analyze test procedures and test results for engineering designs.

CO4: Apply software packages to a range of engineering applications.

Pre-requisite:

Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	M	S				M	W	W	M	S	
CO2	S	S	S	M	S				M	W		M	S	
CO3	M	S	S	M	S				M	W	W	M	S	
CO4	M	S	S	M	S				M	W		M	S	

Course Assessment methods:

Direct	Indirect
Assignment	
Test	
Project	

AUTOMOTIVE MATERIALS **5 Hours**

Material selection - Design codes as applied to vehicle chassis and light-weight materials – Lubrication & maintenance.

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DESIGN & ANALYSIS **9+6 Hours**

3D modeling of engine systems - design of cylinders, cylinder heads - design of suspension system - design of race car chassis - stress analysis, effects of 3D elements elastic constants, fatigue – Matlab Data Analysis.

MOTOSPORT TESTING **9+6 Hours**

Race Car Chassis testing - Engine simulation study, review and testing - Dynamometer testing development and programs - Vehicle data logging and analysis – Grass Kart Testing.

VEHICLE AERODYNAMICS **6+4 Hours**

Vehicle Aerodynamics – Fluids – Head flow analysis – Flow bench analysis – Wind tunnel Testing – CFD.

Theory :30 Hrs **Practical : 15 Hr** **Total Hours: 45**

References:

1. A. Graham Bell, Modern Engine Tuning, Haynes Publishing Group, 1997.
2. A. J. Martyr & M. A. Plint, Engine Testing - The Design, Building, Modification and Use of Powertrain Test Facilities, Elsevier Publications, 4th Edition 2012.
3. Hucho.W.H. - "Aerodynamic of Road Vehicles" - Butterworths Co., Ltd., - 1997.
4. Heldt, P.M., Automotive Chassis, Chilton Book Co., 1992.
5. Dean Averns, Automobile Chassis Design, Illife Book Co., 2001.

Evaluation Method (Internal):

Internal Tests	-	15 Marks
Assignment	-	50 Marks
Project	-	35 Marks
Total	-	100 Marks

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U15GS*T*002 **TOTAL QUALITY MANAGEMENT**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Apply & analyze quality concepts and philosophies of TQM

CO2: Apply concepts of continuous improvement

CO3: Apply TQM concepts to enhance customer satisfaction and deal with customer related aspects

CO4: Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality

CO5: Apply and analyze the TQM tools as a means to improve quality

CO6: Understand quality systems, procedures for its implementation, documentation and auditing

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M		M							M			
CO2		M		M							M			
CO3		M		M							M			
CO4					S						M			
CO5		M			S						M			
					W						M			

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course End Survey
2. Internal Test	
3. Group presentation	
4. End Semester Examination	

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INTRODUCTION **9 Hours**

Definition of Quality, Dimensions of Quality, Quality Costs, Top Management Commitment, Quality Council, Quality Statements, Barriers to TQM Implementation, Contributions of Deming, Juran and Crosby, Team Balancing

TQM PRINCIPLES **9 Hours**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement,5S, Kaizen, Just-In-Time and TPS

STATISTICAL PROCESS CONTROL **9 Hours**

The seven tools of quality, New seven Management tools, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Concept of six sigma

TQM TOOLS **9 Hours**

Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), FMEA

QUALITY SYSTEMS **9 Hours**

Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004

Theory :45 Hours **Total Hours: 45**

References:

1. Dale H.Besterfield, "Total Quality Management", Pearson Education
2. James R.Evans& William M.Lindsay, "The Management and Control of Quality", South-Western (Thomson Learning), 2008.
3. Feigenbaum.A.V."Total Quality Management", McGraw Hill
4. Oakland.J.S. "Total Quality Management", Butterworth – Hcinemann Ltd., Oxford
5. Bhaskar S. "Total Quality Management", (2007-revised edition) Anuradha Agencies, Chennai

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6. Narayana V. and Sreenivasan, N.S. “Quality Management – Concepts and Tasks”, New Age International 2007
7. Zeiri, “Total Quality Management for Engineers”, Wood Head Publishers.

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U15GS*T*003 PRINCIPLES OF MANAGEMENT

Course outcomes

After successful completion of the course, the students should be able to

CO1: Apply the concepts of management and administration and analyze the evolution of management thoughts.
CO2: Apply the concepts of planning, forecasting and decision making
CO3: Analyze organizational structures and apply staffing concepts
CO4: Analyze the motivational and leadership theories
CO5: Apply & analyze the communication and controlling processes.
CO6: Analyze the various international approaches to management

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
COs	Programme Outcomes(POs)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1											M			
CO2											M			
CO3											M			
CO4									M		M			
CO5										M	M			
CO6											M			

Course Assessment methods:

Direct	**Indirect**
1. Assignment	Course End Survey
2. Internal Test	
3 Group presentation	
4. End semester exam	

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MANAGEMENT CONCEPTS **9 Hours**

Management – Definition – Importance – Functions – Skills required for managers - Roles and functions of managers – Science and Art of Management –Management and Administration. Evolution of Classical, Behavioral and Contemporary management thoughts.

PLANNING **9 Hours**

Nature & Purpose – Steps involved in Planning – Forms of Planning – Types of plans – Plans at Individual, Department and Organization level - Managing by Objectives. Forecasting – Purpose – Steps and techniques. Decision-making – Steps in decision making.

ORGANISING **9 Hours**

Nature and Purpose of Organizing - Types of Business Organization - Formal and informal organization – Organization Chart – Structure and Process – Strategies of Departmentation– Line and Staff authority –Benefits and Limitations. Centralization Vs De-Centralization and Delegation of Authority. Staffing – Manpower Planning – Recruitment – Selection – Placement – Induction.

DIRECTING & CONTROLLING **9 Hours**

Nature & Purpose – Manager Vs. Leader - Motivation - Theories and Techniques of Motivation.
Leadership – Styles and theories of Leadership.
Communication – Process – Types – Barriers – Improving effectiveness in Communication.
Controlling – Nature – Significance – Tools and Techniques.

CONTEMPORARY ISSUES IN MANAGEMENT **9 Hours**

Corporate Governance Social responsibilities – Ethics in business – Recent issues. American approach to Management, Japanese approach to Management, Chinese approach to Management and Indian approach to Management.

Theory : 45 Hours **Total:45 Hours**

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REFERENCES:

1. Tripathy PC And Reddy PN, “Principles of Management”, Tata McGraw-Hill, 4th Edition, 2008.
2. Dinkar Pagare, “Principles of Management”, Sultan Chand & Sons, 2000.
3. Kanagasapapathi. P “Indian Models of Economy, Business and Management”, Prentice Hall of India, New Delhi, ISBN: 978-81-203-3423-6, 2008.
4. Vijayaraghavan, G.K.and Sivakumar, M. “Principles of Management”, Lakshmi Publications, 5th Edition, 2009.
5. Bhaskar S. “Principles Of Management”, (2011) Anuradha Agencies, Chennai
6. Harold Koontz & Heinz Weihrich, “Essentials of Management – An International perspective”, 8th edition. Tata McGraw-Hill, 2009.
7. Charles W.L. Hill and Steven L McShane – Principles of Management, Tata Mc Graw-Hill, 2009.

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U15GS*T*004 **OPERATIONS RESEARCH**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Apply linear programming model and assignment model to domain specific situations

CO2: Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results

CO3: Apply the concepts of PERT and CPM for decision making and optimally managing projects

CO4: Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions

CO5: Analyze and apply appropriate inventory techniques in domain specific situations.

CO6: Analyze and apply appropriate queuing theories in domain specific situations

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	S	S		S										
CO2	S	S		S										
CO3	S	S		S							S			
CO4	S	S		S										
CO5	S	S		S										
CO6	S	S		S										

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course End Survey
2. Internal Test	
3. Group presentation	
4. End Semester Examination	

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LINEAR MODEL **9 Hours**

The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique (Big M method, two phase method), duality in simplex

TRANSPORTATION AND ASSIGNMENT PROBLEM **9 Hours**

Transportation model – Initial solution by North West corner method – least Cost method – VAM. Optimality test – MODI method and stepping stone method. Assignment model – formulation – balanced and unbalanced assignment problems

PROJECT MANAGEMENT BY PERT & CPM **9 Hours**

Basic terminologies – Constructing a project network – Scheduling computations – PERT - CPM – Resource smoothening, Resource leveling, PERT Cost

REPLACEMENT AND SEQUENCING MODELS **9 Hours**

Replacement policies - Replacement of items that deteriorate with time (value of money not changing with time) – Replacement of items that deteriorate with time (Value of money changing with time) – Replacement of items that fail suddenly (individual and group replacement policies).

Sequencing models- n job on 2 machines – n jobs on 3 machines – n jobs on m machines, Traveling salesman problem

INVENTORY AND QUEUING THEORY **9 Hours**

Variables in inventory problems, EOQ, deterministic inventory models, order quantity with price break, techniques in inventory management.
Queuing system and its structure – Kendall's notation – Common queuing models - M/M/1: FCFS/∞/∞ - M/M/1: FCFS/n/∞ - M/M/C: FCFS/∞/∞ - M/M/1: FCFS/n/m

Theory :45 Hours **Total Hours: 45**

References:

1. Taha H.A., "Operation Research", Pearson Education
2. Hira and Gupta "Introduction to Operations Research", S.Chand and Co.2002
3. Hira and Gupta "Problems in Operations Research", S.Chand and Co.2008
4. Wagner, "Operations Research", Prentice Hall of India, 2000
5. S.Bhaskar, "Operations Research", Anuradha Agencies, Second Edition, 2004

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U15GS*T*005 **ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Evaluate the economic theories, Cost concepts and pricing policies

CO2: Analyze the market structures and integration concepts

CO3: Apply the concepts of national income and understand the functions of banks and concepts of globalization

CO4: Apply the concepts of financial management for project appraisal and working capital management

CO5: Understand accounting systems

CO6: Analyze financial statements using ratio analysis

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1		M				M					M			
CO2				M		M					M			
CO3						M					M			
CO4				M							S			
CO5											S			
CO6		M		M							S			

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course End Survey
2. Internal Test	
3. Group presentation	
4. End Semester Examination	

ECONOMICS, COST AND PRICING CONCEPTS **9 Hours**

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual Cost and opportunity Cost – Incremental Cost and sunk Cost – Fixed and variable Cost – Marginal Costing – Total Cost – Elements of Cost – Cost curves – Breakeven point and breakeven chart – Limitations of break even chart – Interpretation of break even chart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing policies – Pricing methods.

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CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES **9 Hours**

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration.

NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT **9 Hours**

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

CONCEPTS OF FINANCIAL MANAGEMENT **9 Hours**

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS **9 Hours**

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

Theory :45 Hours **Total Hours: 45**

References:

1. Prasanna Chandra, " Financial Management (Theory & Practice) ,"TMH
2. Weston & Brigham, " Essentials of Managerial Finance"
3. Pandey, I. M., "Financial Management"
4. Fundamentals of Financial Management- James C. Van Horne.
5. Bhaskar S. "Engineering Economics and Financial Accounting", (2003) Anuradha Agencies, Chennai
6. Financial Management & Policy -James C. Van Horne
7. Management Accounting & Financial Management- M. Y. Khan & P. K. Jain
8. Management Accounting Principles & Practice -P. Saravanavel
9. Ramachandra Aryasri.A., and Ramana Murthy V.V.,"Engineering Economics & Financial Accounting"-Tata McGraw Hill, New Delhi, 2006.
10. Varshney R.L., and Maheswari K.L.,"Managerial Economics" – Sultan Chand & Sons, New Delhi, 2001
11. Samvelson and Nordhaus,"Economics"-Tata McGraw Hill, New Delhi, 2002

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U15GS*T*007 **PROFESSIONAL ETHICS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Analyze the various concepts and theories of engineering ethics

CO2: Apply concepts of ethics and analyze its impact on society

CO3: Apply and analyze the concept of safety and risk in the light of engineering ethics

CO4: Analyze and evaluate the rights & responsibilities of engineers

CO5: Analyze the ethical issues engineers are to consider while operating globally

CO6: Applying and analyzing the responsibilities of engineers in management and leadership roles

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1						M		S						
CO2						M		S				M		
CO3						M		S						
CO4						M		S						
CO5						M		S						

Course Assessment methods:

Direct	Indirect
1. Assignment	1. Course End Survey
2. Internal Test	
3. Group presentation	
4. End Semester Examination	

9 Hours

ENGINEERING ETHICS AND THEORIES

Definition, Moral issues, Types of inquiry, Morality and issues of morality, Kohlberg and Gilligan's theories, consensus and controversy, Professional and professionalism, moral reasoning and ethical theories, virtues, professional responsibility, integrity, self respect, duty ethics, ethical rights, self interest, egos, moral obligations.

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SOCIAL ETHICS AND ENGINEERING AS SOCIAL EXPERIMENTATION **9 Hours**

Engineering as social experimentation, codes of ethics, Legal aspects of social ethics, the challenger case study, Engineers duty to society and environment.

SAFETY **9 Hours**

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – the Three Mile Island and Chernobyl case studies. Bhopal gas tragedy.

RESPONSIBILITIES AND RIGHTS OF ENGINEERS **9 Hours**

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – Intellectual Property Rights (IPR) – discrimination.

GLOBAL ISSUES AND ENGINEERS AS MANAGERS, CONSULTANTS AND LEADERS **9 Hours**

Multinational Corporations – Environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – Engineers as trend setters for global values.

Theory :45 Hours **Total Hours: 45**

References:

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”. (2005) McGraw-Hill, New York.
2. John R. Boatright, “Ethics and the Conduct of Business”, (2003) Pearson Education, New Delhi.
3. Bhaskar S. “Professional Ethics and Human Values”, (2005) Anuradha Agencies, Chennai.
4. Charles D. Fleddermann, “Engineering Ethics”, 2004 (Indian Reprint) Pearson Education / Prentice Hall, New Jersey.
5. Charles E. Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and cases”, 2000 (Indian Reprint now available) Wadsworth Thompson Learning, United States.

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U15GST008

FOUNDATIONS SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

Course Objectives:

To facilitate the acquisition of the foundation skills in the process- tools and techniques in the Integrated Product Development area of the Engineering Services industry.

To provide the requisite understanding towards application of academic topics from engineering disciplines into real world engineering projects

Course Outcomes (CO):

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

CO1	Analyze various factors affecting the product development decision and their importance on new product development	K4
CO2	Comparison of various products and services, types and methods of product development, its planning and management.	K4
CO3	Analyze and apply the requirement based on critical parameters and develop system models.	K4
CO4	Apply and analyze the conceptualization, design prototyping ,testing certification and documentation processes related to product development	K3/K4
CO5	Apply and analyze concepts of product maintenance and strategies for obsolescence management, replacement and disposal.	K3/K4
CO6	Demonstrate understanding of product development in academic and real life situations, breakeven and tradeoff analysis in product development, IPR and security aspects related to product development.	K2

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W- Weak

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	S		S		S		W	W	M	W	S		
CO2	M		S			W			M	M	W			
CO3		M	S	W	M									
CO4			S						M	S				
CO5			M	S				M						
CO6							M					M		

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Course Assessment Methods:

Direct	Indirect
• Assignment	• Course End Survey
• Internal Text	•
• Group presentation	•
• End Semester Exam	•

Course Content:

Fundamentals of Product Development **10 Hours**

Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends (Demographic, Behavioral, Psychographic), Technical Trends (Technology, Applications, Tools, Methods), Economical Trends (Market, Economy, GDP, Income Levels, Spending Pattern, target cost, TCO), Environmental Trends (Environmental Regulations and Compliance), Political/Policy Trends (Regulations, Political Scenario, IP Trends and Company Policies); PESTLE Analysis.

Introduction to Product Development Methodologies and Management: Overview of Products and Services (Consumer product, Industrial product, Specialty products etc); Types of Product Development (NPD/ Re-Engineering (Enhancements, Cost Improvements)/ Reverse Engineering/ Design Porting & Homologation); Overview of Product Development methodologies (Over the Wall/ Waterfall/ V-Model/ Stage-Gate Process/ Spiral/Systems Engineering/ Agile); Product Life Cycle (S- Curve, Reverse Bathtub Curve); Product Development Planning and Management (Budgeting, Risk, Resources and Design Collaboration, Scheduling, Change Management, Product Cost Management).

Requirements And System Design **8 Hours**

Requirement Engineering: Types of Requirements (Functional, Performance, Physical, Regulatory, Economical, Behavioral, Technical, Stakeholder, Environmental, Industry specific, Internal-Company Specific); Requirement Engineering (Gathering (VOC), Analysis (QFD), Design Specification); Traceability Matrix and Analysis; Requirement Management.

System Design & Modeling: Introduction to System Modeling; System Optimization; System Specification; Sub-System Design; Interface Design.

Design And Testing **13 Hours**

Conceptualization: Industrial Design and User Interface Design; Introduction to Concept generation Techniques; Concept Screening & Evaluation - Concept Design, S/W Architecture, Hardware Schematics and simulation.

Detailed Design: Component Design and Verification; High Level Design/Low Level Design of S/W Programs, S/W Testing; Hardware Schematic, Component design, Layout and Hardware Testing. **Prototyping:** Types of Prototypes (Mockups, Engineering Assessment Prototype, Alpha, Beta, Gama); Introduction to Rapid Prototyping and Rapid Manufacturing. **System Integration, Testing, Certification and Documentation:** Manufacturing/Purchase and Assembly of Systems; Integration of Mechanical, Embedded and S/W systems; Introduction to Product verification processes and stages – Industry specific (DFMEA, FEA, CFD); Introduction to Product validation processes and stages - Industry specific (Sub-system Testing/ Integration Testing/ Functional Testing/ Performance Testing / Compliance Testing); Product

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Testing standards and Certification – Industry specific; Product Documentation (Compliance Documentation, Catalogue, Brochures, user manual, maintenance Manual, Spares Parts List, Warranty, Disposal Guide, IETMS, Web Tools).

Sustenance Engineering And End-Of-Life (Eol) Support **6 Hours**

Sustenance: Maintenance and Repair; Enhancements. **Product EoL:** Obsolescence Management; Configuration Management; EoL Disposal.

Business Dynamics – Engineering Services Industry **8 Hours**

The Industry: Engineering Services Industry – Overview; Product development in Industry versus Academia.

The IPD Essentials: Introduction to vertical specific product development processes; Product development Trade-offs; Intellectual Property Rights and Confidentiality; Security and Configuration management.

Theory: 45 hours **Tutorials: 0 hours** **Total Hours: 45**

References:

1. Foundation Skills in Integrated Product Development (FSIPD), First Edition, 2013, Published by NASSCOM.
2. Ulrich, Karl T. and Eppinger, Steven D, "Product Design and Development", McGraw-Hill, Fifth Edition, 2012.
3. Kevin N. Otto, "Product design – Techniques in Reverse Engineering and New Product Development", PEARSON, New Delhi, 2011.

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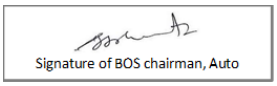
ONE CREDIT COURSES



U15AU*I*N01 **OVERVIEW OF MOTORSPORTS ENGINEERING**

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the various events of motorsport engineering

CO2: Understanding the rules and regulation for the different motor sports events

CO3: Understanding the career opportunities in motor sports engineering

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			S			S								S
CO2			S				S	S		M	S			S
CO3							S					S		S

Course Assessment methods:

Direct	Indirect
1. Quiz	2. Exit Survey
3. Seminar / Case Study Report	

INTRODUCTION TO MOTORSPORT ENGINEERING **2 Hours**

The history of motorsport engineering-Review of motorsport engineering-Pioneers of Motorsport engineering -Motorsport technology evolution review.

LIST OF MOTORSPORT COMPETITIONS FOR STUDENTS **3 Hours**

A brief look at all the events students can take part to develop their skills - Formula SAE - Baja SAE - SAE Super mileage.

PROFESSIONAL MOTORSPORT EVENTS **4 Hours**

The various types of professional motorsport events that take place around the world - Cars – Formula One, World rally championship, Touring car championship, GP2, GP3, World Endurance Racing Championship, dirt track racing, NASCAR, Indy Car, Cross Country rallies, drag racing - Motorcycles – MotoGP, Superbike, Endurance, Motocross, Supermoto, Freestyle, Trials, Cross-country rallies, Speedway, Board track, drag racing

RULES AND REGULATIONS OF MOTORSPORTS **3 Hours**

Introduction about the rule book - About - the world governing bodies of the sport - Why the rule book keeps changing - How to interpret the rule book- Rules for car races - Rules for bikes races

CAREER IN MOTORSPORTS ENGINEERING **3 Hours**

Motorsport Engineer Race Driver / Rider - Test Driver / Rider - Design engineer - Race technician -Aerodynamics Engineer - Race official / steward

Total Hours: 15

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U15AU*I*N02 AUTOMOTIVE STYLING

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the design trends of concept cars

CO2: Apply the concept of ergonomics in designing concept cars

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	W											S	
CO2		M										M	S	

Course Assessment methods:

Direct	Indirect
1. Quiz	
2. Seminar	

DESIGN EXPRESSIONS **4 Hours**

Design methodology, Lifestyle board, Mood board, Theme board, Design trends, Design movements, Application of design principles and product aesthetics

INTRODUCTION TO CONCEPT CARS **4 Hours**

Importance of concept cars, Blending technology, Form in concept cars

CAR DESIGN **4 Hours**

Art and colour, Product styling, Introduction to human factors engineering, Digital design, Concept to reality, Auto show vehicles

VISUAL FACTORS IN DESIGN **3 Hours**

Colour harmony, Colour in design, Artist's spectrum, Basic color schemes

Total Hours: 15

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U15AU*I*N03 **ELECTRONIC ENGINE MANAGEMENT SYSTEMS**

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Familiarize the importance of ECU for better performance of engines.

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		S			M	S			M		W	S	
CO2	M		S			M	S					M	S	

Course Assessment methods:

Direct	Indirect
1. Quiz	
2. Seminar	

Topics covered

- An overview of Engine Management System
- Current trends in automotive electronic engine management system
- Control of SI & CI engines for better performance and low emissions
- Closed loop control of engine parameters of fuel injection and ignition.
- Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation.
- Electronics emission control techniques

Total Hours 15

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U15AU*I*N04 VEHICLE SERVICE MANAGEMENT

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the Automotive vehicle servicing

CO2: Understand the parts ordering management

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		S			M	S			M		W		S
CO2	M		S			M	S					M		S

Course Assessment methods:

Direct	Indirect
1. Test	
2. Quiz	
3. Assignment / Case study	

SERVICE MARKETING **4 Hours**

Services economy– evolution and growth of service sector, service quality, Focus on Customers - customer expectations, building service customer relationship, Service market segmentation

SERVICE DESIGN AND DELIVERY **4 Hours**

Service life cycle, service core process – distributing service direct distribution, channel functions, channels selection, impact of information technology, service recovery, Repair order analysis.

PARTS MANAGEMENT **4 Hours**

Parts management, inventory control, staffing and productivity, ordering parameters, parts marketing, merchandising, retailing and trade activities.

BUSINESS PLANNING **3 Hours**

Audits- for performance Management. SoP's for process compliance. How to conduct Daily Management meeting for service.

Total Hours: 15

References:

1. Kenneth E Clow, et. al "Services Marketing Operation Management and Strategy" Biztantra, New Delhi, 2004.
2. ChiristropherH.Lovelock, JochenWirtz, "Services Marketing", Pearson Education, New Delhi, 2004.
3 Halen Woodroffe, "Services Marketing", McMilan Publishing Co, New Delhi 2003.

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U15AU*I*N05 VEHICLE MAINTENANCE

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the Basics of maintenance & workshop statements preparation

CO2: Understand the Engine, Chassis, Electrical Maintenance systems

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		S			M	S			M		W		S
CO2	M		S			M	S					M		S

Course Assessment methods:

Direct	Indirect
1. Test	
2. Quiz	
3. Assignment / Case study	

MAINTENANCE OF RECORDS AND SCHEDULES **2 Hours**

Preventive (scheduled) and breakdown (Unscheduled) maintenance, requirements of maintenance, preparation of check Lists, Inspection schedule, maintenance of records, log sheets.

ENGINE MAINTENANCE **4 Hours**

List of Engine components and cleaning methods, visual and Inspections, minor reconditioning of various components, Reconditioning methods, special tools used for maintenance.

CHASSIS MAINTENANCE **6 Hours**

Maintenance of Automobile clutch, gear box, drive, suspension, Brake and Steering systems.

ELECTRICAL SYSTEM MAINTENANCE **3 Hours**

Testing methods battery, starter motor, charging, Ignition and lighting Systems. Checking and servicing of dash board instruments.

Total Hours: 15

References:

1. John Doke, “Fleet Management”, McGraw Hill Co. 1984.
2. James D Halderman, “Advanced Engine Performance Diagnosis”, PHI, 1998.
3. Service Manuals from Different Vehicle Manufacturers.

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U15AU*I*N06 INTELLECTUAL PROPERTY RIGHTS

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the IPR and its classification

CO2: Understand the Patens for Inventions

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		S			M	S			M				M
CO2	M		S			M	S							M

Course Assessment methods:

Direct	Indirect
1. Test 2. Quiz 3. Assignment / Case study	

Module:

1.Overview on IPR and its classification	**3 Hours**
2.Patents	**4 Hours**
3.International Conventions related to IPR	**4 Hours**
4.Patens for Inventions in Automotive Engineering - Case Studies	**4 Hours**
	Total Hours: 15

References:

1. T. M Murray and M.J. Mehlman, Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons 2000
2. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi , 2010

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U15AU*I*N07 LEAN MANUFACTURING AND SIX SIGMA

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the Concept of Six Sigma and Value Engineering

CO2: Understand the Concept of Reliability Engineering and Learn Manufacturing

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W	W				W	M							
CO2	M	W				W	M			W				

Course Assessment methods:

Direct	Indirect
1. Test 2. Quiz 3. Assignment / Case study	

Module:

1. Concept of Six Sigma	**3 Hours**
2. Value Engineering	**4 Hours**
3. Reliability Engineering	**4 Hours**
4.Learn Manufacturing -Case Studies	**4 Hours**

Total Hours: 15

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U15AU*I*N08 OFF ROAD VEHICLE

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the need and application of various off road vehicles

CO2: Understand the power transmission and sub systems of an off road vehicle.

Pre-requisite:

1. Basics of Automobile Engineering

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		W	W				W	M						
CO2		M	W				W	M						

Course Assessment methods:

Direct	Indirect
1. Test	
2. Quiz	
3. Assignment / Case study	

Module:

1. Introduction to off road Vehicles **3 Hours**
2. Classification and requirements of off road vehicles **4 Hours**
3. Application in Military, Agriculture and Construction **4 Hours**
4. Modern off road vehicles **4 Hours**

Total Hours: 15

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U15AU*I*N09 INDUSTRIAL SAFETY

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the Safety in Industrial Layout and Logistics

CO2: Understand the Safety in Manufacturing process and Fuel storage and Fire Safety

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W	W				W	M							
CO2	M	W				W	M			W				

Course Assessment methods:

Direct	Indirect
1. Test	
2. Quiz	
3. Assignment / Case study	

Module:

1. Safety in Industrial Layout	**3 Hours**
2. Safety in Manufacturing process	**4 Hours**
3.Safety in Logistics	**4 Hours**
4. Fuel storage and Fire Safety	**4 Hours**

Total Hours: 15

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U15AU*I*N10 COMMERCIAL VEHICLE TECHNOLOGIES

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the CVT and Commercial Vehicles

CO2: Understand the Dynamic behaviour of vehicle and Manufacturing engineering of commercial vehicle

Pre-requisite:

1. Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W	W				W	M							
CO2	M	W				W	M			W				

Course Assessment methods:

Direct	Indirect
1. Test 2. Quiz 3. Assignment / Case study	

Module:

Introduction - CVT	**3 Hours**
Principles of Commercial Vehicles	**4 Hours**
Dynamic Behaviour of vehicle	**4 Hours**
Manufacturing engineering of commercial vehicle	**4 Hours**

Total Hours: 15

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U15AUOE01 AUTOMOTIVE ENGINEERING

L	T	P	C
3	0	0	3

Course Outcomes(COs)

After successful completion of this course, the students should be able to:

CO1: Classification and layouts of different vehicles
CO2: Different types of Engines in use
CO3: Different types of clutch, gear box and transmission used
CO4: Different types of brakes, drivelines and wheels and tyres

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	W	W				W	M				S	W
CO2	W	W				W	M				S	W
CO3	W	W				W	M				S	W
CO4	W	W				W	M				S	W

Course Assessment methods:

Direct	Indirect

1. Assignment
2. Internal Test
3. End Semester Examination

VEHICLE CLASSIFICATION AND LAYOUTS **9 Hours**

Study various vehicle layouts as front engine & front wheel drive, front engine & rear wheel drive, rear engine & rear wheel drive. Classification based on controls positioning. Types of Chassis frames & construction of Chassis frame and vehicular Body

ENGINE TYPES (BASED ON FUEL USED) **5 Hours**

Gasoline, Diesel, LPG, CNG, Bio-Diesel (Basic study)

CLUTCH, TRANSMISSION AND BRAKES **11 Hours**

Functions and type of clutches, single plate, multiple plates, centrifugal. Vehiclemotion, resistances during motion, accelerated and constant velocity motions, tractive force, gradeabilty, power required and engine characteristics, gear ratio requirement. Manual Gear Boxes - Sliding mesh, constant mesh, synchromesh, epicyclical gear boxes, gear ratios, Automatic transmission. Service Brakes - Function, Internal expanding brakes, shoes and lining material, properties, hydraulic braking system, brake oil, bleeding of brakes, pneumatic braking system and vacuum brakes. Auxiliary Brakes - Exhaust brakes, parking brake.

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STEERING, FRONT AXLE AND SUSPENSION **11 Hours**

Steering requirements, steering gears box types, steering system and linkages, steering geometry, wheel alignment, toe-in, toe-out, caster, camber, power steering. Purpose of front and rear suspension, types of suspension system, coil spring, leaf spring, torsion bars, shock absorbers, air suspensions, independent suspension and McPherson strut .

DRIVE LINE, REAR AXLES AND WHEELS AND TYRES **9 Hours**

Propellers shaft, final drive types, Bevel, hypoid, Drive axles & differential, fully or semi-floating and three quarter floating, dead axle. Types of wheel, rims, tread patterns of tyre, tubeless tyres, and specifications of tyres.

Theory :45 Hr **Total Hours: 45**

References:

1. Dr. Kirpal Singh, "*Automobile Engineering (Volume – 1&2)",* 12th Edition, Standard Publishers Distributors, 2011.
2. Rajput.R.K, *"A Text Book of Automobile Engineering*", Laxmi Publications (P) Ltd, 2007.
3. Kamaraju Ramakrishna, *"Automobile Engineering*", Printice Hall of India, 2012

Other references:

1. Donald L Anglin, William H Crouse, "Automotive Mechanics 10 Edition", TATA McGraw Hill Education, 2006

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L	T	P	C
3	0	0	3

U15AUOE02 ELECTRIC AND HYBRID VEHICLES

Course Outcomes(COs)

After successful completion of this course, the students should be able to:

CO1: Understand working of different configurations of components

CO2: Understand different configurations of electric vehicles and its performance

Pre-requisite:

1. Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M									M
CO2					M			S				

Course Assessment methods:

Direct	Indirect

1. Assignment
2. Internal Test
3. End Semester Examination

ELECTRIC VEHICLES 9 Hours

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

BATTERY 9 Hours

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

DC & AC ELECTRICAL MACHINES 9 Hours

Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines

ELECTRIC VEHICLE DRIVE TRAIN 9 Hours

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

HYBRID ELECTRIC VEHICLES 9 Hours

Types – series, parallel and series-parallel configuration – Design – Drive train, sizing of components.

Theory :45 Hr **Total Hours: 45**

References:

1. Iqbal Hussain, “Electric & Hybrid Vechicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.

Other references:

1. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2001

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U15AUOE03 **AUTOMOTIVE ELECTRONIC SYSTEMS**

L	T	P	C
2	0	2	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Describe various mechanical systems in an automobile (K2).

CO2: Illustrate different types of electronic systems in an automobile (K3).

CO3: Outline the various stages of Integrated development environment to design an embedded System (K4).

CO4: Explain the various embedded systems used in automotive applications (K2).

Pre-requisite:

1. Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S										M	
CO2	S	M		M								
CO3		M			M		M					
CO4	S	M										

Course Assessment methods:

Direct	Indirect
1. Internal Test – I	1. Course Exit Survey
2. Internal Test – II	
3. Assignment	
4. End Semester Exam	

AUTOMOTIVE MECHANICAL SYSTEMS: VEHICLE SYSTEMS **8 Hours**

Power Train System (Air System, Fuel System (Carburettor & Diesel Fuel Injection, Ignition System, Exhaust System and other Auxiliary Systems (Cooling, Lubrications & Electrical Systems)), Transmission System (Front, Rear & 4 wheel Drive, Manual, Automatic Transmission, Differential). Braking System (Drum, Disc, Hydraulic, Pneumatic), Steering System (Rack and Pinion, Power Steering).

ELECTRONICS IN AUTOMOTIVE SYSTEMS **8 Hours**

Need for Electronics in Automotive Systems, Overview of Vehicle Electronic Systems, Basic electrical components and their operation in an automobile: Power train subsystem (Starting systems, Charging systems - Ignition systems – Electronic fuel control), Chassis subsystem (ABS, TCS, & ESP) – Comfort and safety subsystems (Night Vision, Airbags, Seatbelt Tensioners, Cruise Control-Lane departure warning, Parking).

INTEGRATED DEVELOPMENT ENVIRONMENT **6 Hours**

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Introduction to Integrated development environment (IDE) – Getting started, HW / SW configuration (boot service, Host – target interaction) – Booting reconfiguration – Managing IDE – Target servers, agents, Cross development, debugging

EMBEDDED SYSTEM AND COMMUNICATION PROTOCOLS IN AUTOMOTIVE APPLICATIONS **8 Hours**

Engine management systems – Gasoline / Diesel systems, various sensors used in system – Electronic transmission control – Vehicle safety system – Body electronics – Infotainment systems – Navigation systems

Introduction to control networking - Vehicle communication protocols – Introduction to CAN, LIN

LIST OF EXPERIMENTS: **30 Hours**

1. Anti Pinch System for power windows
2. Speed Measurement using proximity sensor
3. Automatic headlamp dimming on stopping the vehicle
4. AC Monitoring and control using temperature sensor with status indicators/display.
5. Wiper Control system with water pump, wiper motor with status indicators.
6. Electronic boot release, fuel lid open system with indicators.
7. Automatic door-lock, on vehicle movement with status indicators.

Theory :30 Hrs **Practical : 30Hrs** **Total Hours: 60**

References:

1. Joerg Schaeuffele, Thomas Zurawka ,“ Automotive Software Engineering – Principles, Processes, Methods and Tools”, SAE International,2005.
2. BOSCH Automotive Handbook, 6th Edition,2014.
3. Jean J.Labrosse, “ µC/OS-II Real Time Kernel”, CMP Books,2nd edition,2002.

Other references:

1. Denton.T , “Automobile Electrical and Electronic Systems”, 4th edition, Routledge, 2012.
2. Knowles.D, “Automotive Electronic and Computer Controlled Ignition Systems”, Reston Pub Co,1988.
3. William T.M., “Automotive Electronic Systems”, Heiemann Ltd., London, 1978.
4. Ronald K.Jurgen, “Automotive Electronics Handbook”, McGraw Hill Publications, 1999.
5. William Ribbens,. Understanding automotive electronics: an engineering perspective. Butterworth-Heinemann, 2012.
6. Nicholas Navit, “Automotive Embedded System Handbook”, CRC Press, Taylor and Francis Group, 2009.

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U15AUOE04

VEHICLE DEALERSHIP MANAGEMENT

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the basic concepts of dealership.
CO2: Apply a strategic perspective of the retailing industry
CO3: Apply the concept of management in parts ordering, servicing.

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M								M			M
CO2	M								M			M
CO3	M								M			M

Course Assessment methods:

Direct	Indirect
1. Continuous assessment tests	1. Course Exit Survey
2. Assignment	
3. End semester exam	

DEALERSHIP **9 Hours**

Understanding Dealership Infrastructure requirements. Furnishing dealership. Preparing dealer manual.

SHOWROOM MANAGEMENT **9 Hours**

Contemporary showroom management. Institutionalising, structuring and monitoring the sales process, managing the showroom floor and the sales team. Retail developments and industry trends

SERVICE MANAGEMENT **9 Hours**

Service management, process and fundamentals, repair order analysis, productivity and efficiency, scheduling, loading, warranties and service retention.

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PARTS MANAGEMENT **9 Hours**

Parts management, inventory control, staffing and productivity, ordering parameters, parts marketing, merchandising, retailing and trade activities.

9 Hours

CASE STUDY

Applying theory in practice working case study of an actual dealership, group presentations and action planning.

Theory :45 Hr **Total Hours: 45**

References:

1. A.Sivakumar (1997), Retail Management, Excel Books, New Delhi.
2. Kapil Sharma (2009), Marketing Management, Global India Publication Pvt.Ltd., New Delhi.
3. KVS Madaan (2009), Fundamentals of Retailing, Tata McGraw Hill, New Delhi

Other references:

1. Gibson G.Vedamani (2003), Retail Management, Jaico Publishing House, New Delhi

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