#### **Department of Mechanical Engineering**

Scheme of Teaching and Examinations Bachelor of Technology (Mechanical Engineering with Specialization in Automotive Engineering)

#### <u>W.E.F 2025</u>



# DELHITECHNOLOGICALUNIVERSITY (Formerly Delhi College of Engineering) (Estd. By Govt. of NCT of Delhi vide Act 6 of 2009)

Delhi Technological University (Formerly Delhi College of Engineering) Shahbad Daulatpur, Bawana Road, Delhi – 110 042

### Vision & Mission of the University

### VISION

To be a world class university through education, innovation and research for the service of humanity.

### MISSION

- 1. To establish centres of excellence in emerging areas of science, engineering, technology, management and allied areas.
- 2. To foster an ecosystem for incubation, product development, transfer of technology and entrepreneurship.
- 3. To create environment of collaboration, experimentation, imagination and creativity.
- 4. To develop human potential with analytical abilities, ethics and integrity.
- 5. To provide environment friendly, reasonable and sustainable solutions for local & global needs.

## DEPARTMENT OF MECHANICAL ENGINEERING

### VISION

To become a global hub of academic excellence, research and innovation in the field of Mechanical, Production & Industrial, and Automobile Engineering.

#### MISSION

To produce world class skilled Mechanical, Production & Industrial, and Automobile Engineers by imparting quality education through cutting edge technologies, and Research & Development enabling them to work towards sustainable professional development

## Program Educational Objectives (PEOs)

#### Mechanical Engineering with Specialization in Automotive Engineering

PEO 1: Graduate shall have ability to understand and apply core subject knowledge to various production industrial engineering problems. and PEO 2: The graduates will be able to work in team, investigate the problem of production engineering and present an ecological sustainable solution. PEO 3: The graduates shall be competent in engineering modelling and experimental capabilities to pursue research and higher education in production and industrial engineering.

PEO 4: The graduates shall have good communication skill, high ethical and social values.

#### **Program Specific Outcomes (PSOs):**

**PSO1:** An ability to identify industrial problems and to provide solutions with the help of production engineering tools.

PSO2: An ability of collaborative learning to find out sustainable, solution for social issues

**PSO3:** Apply the knowledge of Manufacturing Engineering and Engineering Management to the solution of complex Engineering Problems through empathy and creativity.

### **Program Outcomes (POs)**

### Engineering Graduates will be able to:

**POs1:** Engineering knowledge : Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**POs2:** 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.

**POs3:** 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.

**POs4:** 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.

**POs5:** 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.

**POs6:** 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.

**POs7:** 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.

**POs8:** Ethics : Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**POs9:** Individual and teamwork : Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**POs10:** 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.

**POs11:** 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.

**POs12:** Lifelong 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.

# **BACHELOR OF TECHNOLOGY**

S. No.	Code	Title	Area	ŗ	_	н	٩	Ħ	Hd	CWS	PRS	MTE	ETE	PRE
1.	AE301	Manufacturing technology	DCC	4	3	0	2	3	0	15	25	20	40	-
2.	AE303	Design of Machine elements	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	AE305	Measurements and Instrumentation	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	HU301	Engineering Economics	HMC	3	3	0	0	3	0	25	0	25	50	
5.	AE3XX	Department Elective course I	DEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	
6.	AE3XX	Generic Elective course I	GEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	
		Total		23										

# Mechanical Engineering with Specialization in Automotive Engineering III Year: Fifth Semester

# **III Year: Sixth Semester**

S. No.	Code	Title	Area	c	_	н	٩	Ħ	Hd	CWS	PRS	MTE	ETE	PRE
1.	AE302	I C Engines	DCC	4	3	0	2	3	0	15	25	20	40	-
2.	AE304	Alternative fuels and energy systems	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	MG302	Fundamentals of management	HMC	3	3	0	0	3	0	25	0	25	50	-
4.	AE3XX	Department Elective course 2	DEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	-
5.	AE3XX	Department Elective course 3	DEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	-
6.	AE3XX	Generic Elective course 2	GEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	-
		Total		23										

S. No.	Code	Title	Area	ъ		н	٩	H	Hd	CWS	PRS	MTE	ETE	PRE
1.	AE401	BTECH PROJECT I	DCC	4	-	-	-	-	-	40	-	-	60	
2.	AE403	Internship	DCC	4	-	-	-	-	-	40	-	-	60	-
3.	AE4XX	Department Elective course 4	DEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	-
4.	AE4XX	Department Elective course 5	DEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	-
5.	AE4XX	Generic Elective course 3	GEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	-
6.	AE4XX	Indian Knowledge System	VAC	No Credit	-	-								-
		Total		18										

## **IV Year: Seventh Semester**

# **IV Year: Eighth Semester**

S. No.	Code	Title	Area	Cr	L	T	Р	ΗL	Hd	CWS	PRS	MTE	ETE	PRE
1.	AE402	BTECH PROJECT II	DCC	8	-	-	-	-	-	80	-	-	120	-
2.	AE4XX	Department Elective course 6	DEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	-
3.	AE4XX	Generic Elective course 4	GEC	4	3	0/1	2/0	3	0	15/25	25/0	20/25	40/50	-
		Total		16										

# List of Departmental Elective Courses

S. No.	Elective Code	Title of Elective	Elective no.
1	AE-307	Combustion Generated Pollution	
2	AE-309	Operation Research	
3	AE-311	Tyre Technology	
4	AE-313	Thermal Engineering	DEC 1
5	AE-315	Turbo machinery and gas dynamics	DEC-1
6	AE-317	Power units and transmission	
7	AE-319	Computer Simulation of I.C. Engine Process	
8	AE-321	Advanced strength of material	
9	AE-323	Finite Element Methods and Applications	
10	AE-306	Automotive Aerodynamics & CFD	
11	AE-308	Advanced Manufacturing Technology	
12	AE-310	Quality Management & Six Sigma Applications	
13	AE-312	Metrology	
14	AE-314	Advances in Welding & Casting	
15	AE-316	Materials for automobile components	
16	AE-318	Tribology and lubrication	DEC-2,3
17	AE-320	Reliability & Maintenance Engineering	
18	AE-322	Elastic & Plastic Behaviour of Materials	
19	AE-324	Production Planning & Inventory Control	
20	AE-326	Supply Chain Management	
21	AE-328	Computer Integrated Manufacturing Systems	

22	AE405	Design of Automobile Components	
23	AE407	Production And Operations Management	
24	AE409	Computer Aided Vehicle Design and Safety	
25	AE-411	Vehicle Maintenance & Tribology	
26	AE-413	Vehicle Transport Management	
27	AE-415	Power Plant Engineering	
28	AE-417	Robotics & Automation	DEC-4,5
29	AE-419	Nuclear Energy	
30	AE 421	Product design and development	
31	AE 423	Financial Management	
32	AE 425	Fracture mechanics	
33	AE-404	Total Life Cycle Management	
34	AE-406	Refrigeration & Automobile Air Conditioning	
35	AE-408	Fuel Cells	
36	AE-410	Modern Vehicle Technology	
37	AE-412	Automobiles Vibration System Analysis	DEC-6
38	AE-414	Renewable Energy Sources	
39	AE-416	Vehicle Safety Engineering	
40	AE-418	Packaging Technology	
41	AE-420	Mechatronics	
42	AE-422	Tractors and Farm Equipment and Off-Road Vehicles	
43	AE-424	Automobile process control	

# **III Year: Fifth Semester**

	CODE: AE301 Title: Manufacturing technology											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0	2	4	DCC		15	25	20	40	-		

**Objectives:** To introduce student with various types of conventional machines, unconventional machines, theory of metal cutting, design of tools and methods of measurement

Syllabus		Contac t
Unit-1	<b>Conventional Machining:</b> General Principles (With Schematic Diagrams only) of Working, Types and Commonly Performed Operations in the Following Machines - Lathe, Shaper, Planer, Milling Machine, Drilling Machine, Grinding Machine, Gear Cutting - Basic of CNC Machine.	Hours 7
Unit-2	<b>Unconventional Machining Processes:</b> Need for Unconventional Machining Processes – Non- conventional machining: Studies on basic principle, working and effects of process parameters of the following processes: Ultrasonic machining (USM), Abrasive jet machining (AJM), Electro- discharge machining (EDM), Electrochemical machining (ECM), Electron beam machining (EBM), Plasma arc machining (PAM) and Laser beam machining (LBM). Ion Beam Machining (IBM), Biochemical Machining	7
Unit-3	<b>Theory of Metal Cutting:</b> Mechanics of metal cutting- Orthogonal and oblique cutting, Chip formation, Types of chips, Chip control, Merchants theory of cutting forces at tool point, Limitations and modifications of Merchants theory, Plowing forces and the 'Size effect', Heat generation in metal cutting, Cutting fluids and their physical action, Tool wear, Tool life and Machinability, Nomenclature of cutting tools and Cutting tool materials, Economics of machining, Analysis of milling and grinding processes.	7
Unit-4	<b>Design Features of Machine Tools:</b> Design requirements of machine tools, Kinematic drives of machine tools, Types of machine tool drives, Design of machine tool spindle.	7
Unit-5	<b>Jigs &amp; Fixtures:</b> Important considerations in jigs and fixture design. Main principles of designing of jigs & fixtures. Different devices and methods of locations. Different types of clamps used in jigs & fixtures.	8
Unit-6	Metrology: Introduction to Metrology and its relevance, Linear and angular measurements.	6
	Total	42

Ref	erence Books:
1	HajraChoudury, "Elements of Workshop Technology", Vol. I andVol. II, Asia Publishing House, 1996. (ISBN- 13-9788185099149)
2	B S Raghuwanshi, "Production Technology" Vol. 1,2 (ISBN-4567144376)
3	P N Rao "Manufacturing Technology", Vol.1, Tata McGraw Hill, 2003. (ISBN9781259062575) 4 )
4	Sharma P.C., "A Text Book of Production Engineering", Vol.1, S. Chand Publication, New Delhi, 2001. (ISBN-9788121901116
5	Geoffrey Boothroyd, "Fundamentals of Machining & Machine Tools" Winston A. Knight, Marcel & Dekker Publications. (ISBN-10:1574446592)

CO1	To study the construction and working of conventional manufacturing machines And analyze its parameters
CO2	To study the construction and working of unconventional manufacturing machines. And analyze its parameters
CO3	To study and analyse metal cutting types and their complete analysis in term of quality ,cost and tine required.
CO4	To study about different drives ,spindle of machine tool.
CO5	To study about jig and fixtures for different applications
CO6	To study concept of measurement and its types.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	CODE: AE303 Title: Design of Machine elements										
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE	
3	0	2	4	DCC		15	25	20	40	-	

**Objectives:** Student should be aware about the principle of design, aesthetics consideration in design. He should be able to understand the principle of welded joint, shaft and coupling drives and brakes

Syllabus		Contact Hours
Unit-1	<b>Introduction:</b> Principles of mechanical design, systematic design process, aesthetic and ergonomic considerations in design, use of standards in design. Manufacturing consideration in design, casting, machining, forging. Dynamic and fluctuating stresses, fatigue failure and endurance limit, stress concentration, causes and remedies in design, Factor of safety, Tolerances and types of fits. Selection of materials.	8
Unit-2	<b>Design of Elements:</b> Cotter and knuckle joints; screwed fastenings, bolted and riveted joints under direct and eccentric loads.	6
Unit-3	Welded Joints: Welded joints, strength of welded joints, eccentrically loaded joints, welded joints subjected to bending moment and torsion	7
Unit-4	<ul> <li>Shafts and Couplings: Shafts, keys and couplings –design of rigid and pin bushed flexible couplings</li> <li>Translation screws: Force analysis and design of various types of power screws. Springs, uses and design of close coiled helical springs.</li> </ul>	7
Unit-5	Mechanical Drives: Selection of transmission, helical, bevel and worm gears, belt and chain drives.	8
Unit-6	Friction Clutches & Brakes: Common friction materials, shoe, band, cone and disc brakes, their characteristics and design, friction clutches	6
	Total	42

Ref	Reference Books:							
1	Maleeve Hartman and O.P.Grover,"Machine Design", Publisher- CBS Publication & Publishers (ISBN-							
	8123906374)							
2	V.B. Bhandari,"Machine Design", Publisher - Tata McGraw Hill(ISBN- 9780070681798							
3	P.C. Sharma and D.K Aggarwal.,"Machine Design", Publisher-S.K. Kataria & Sons(ISBN-9350142813)							
4	Mahadevan,"Design Data Book", Publisher-CBS Publishers & Distributors (ISBN- 8123901623)							
5	I.E. shigley & C.R. Mischke,"Mechanical Engineering Design",Publisher-Tata McGraw Hill Co.Inc.(ISBN-							
	9780072832099)							

CO1	To understand the basics of mechanicals design ,use of standards, material selection,,design considerations in manufacturing, stress concentarion.
CO2	To understand different joints under different loading
CO3	To study and analyze welded joints
CO4	To understand and apply the concept of keys, shaft and coupling. And springs in practicle.
CO5	To study and apply the concept of mechanical deives.
CO6	To understand the Friction Clutches & Brakes: designs i

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	<b>CODE:</b> AE305 <b>Title:</b> Measurements and Instrumentation									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0	2	4	DCC		15	25	20	40	-

**Objectives:** To familiarize and analyze the instrument's performance, understand different types of measuring instruments, and apply their knowledge to measure physical quantities

Syllabus	3	Contac t Hours
Unit-1	<b>Basic concepts, Generalised Measurement System:</b> definition of terms, calibration, standards and errors, static and Dynamic performance characteristics; analysis of experimental data	8
Unit-2	instrumentation for measurement of Position and displacement, force, Strain, pressure, temperature, proximity and range. Concept of feedback;	6
Unit-3	<b>open and close loop systems:</b> Loop control systems, transducers and devices for applications, digital readouts, data Acquisition and processing.	7
Unit-4	introduction, measuring instruments, measuring range, sensitivity, repeatability, precision and accuracy. Standards: definitions of line standard, end standard and wavelength standard, sub divisions of Standards. Slip gauges. Measurement of angles: introduction, bevel venire protractor, sine bar, angel gauges, spirit level, Autocollimator, angle dekkor, rotary tables, precision polygon, calibration of polygons. Measurement of internal and external tapers	7
Unit-5	<b>Measurement of threads:</b> introduction, screw thread terminology, pitch error, angle error, measurement of major and minor diameter, measurement of effective diameter by one wire, two wire and three wire Method. Best size wire. Measurement of surface finish: introduction, surface texture, surface roughness terminologies, methods of measuring surface finish, stylus probe instruments, taylor hobson talysurf, sample length or cut off Length, analysis of surface traces.	8
Unit-6	<b>Gear measurements:</b> introduction, terminology of gear tooth, errors in manufacturing gears, rolling Test, measurement of tooth thickness, Parkinson gear tester. Inspection of straightness, flatness, and alignment. Interferometry and use of optical flats. Measurement of coordinates using coordinate measuring machine	6
	Total	42

Ref	erence Books:
1	T.G.Beckwith,"Mechanical measurements", N. L. Buck and R. D. Marangoni, 3rd Ed, Narosa Publishing house.1993, ISBN 10: 0201004542 ISBN 13: 9780201004540
2	R. K. Jain,"Metrology",Khanna pub. 2002, ISBN-13978-81-7409-153/ISBN-1081- 7409-153
3	C. Dotson,"Fundamentals of dimensional metrology", R. Harlow and R. Thomson. Pub. 2003, ISBN-13: 978-1418020620/ISBN-10: 1418020621
4	B. C. Nakra and K. K. Chaudhari,"Insrumentation, measurement and analysis",Tata McGraw-Hill, 19855, ISBN 0070482969, 9780070482968
5	Turner and Hill,"Instrumentation for Engineers and Scientists", Oxford university Press, ISBN-10: 0198565178ISBN-13: 978-0198565178

CO1	To Study the basic concept of measurement and its performance characteristics.
CO2	To explain about open loop and close loop systems.
CO3	To describe the measurement calibration and it's all terms.
CO4	To analyze the performance characteristics of each instrument
CO5	To explain the concept of measurement for various practical problems.
CO6	To apply the knowledge of measurement for various case studies.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	CODE: HU301 Title: Engineering Economics									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0	0	3	HMC		25		25	50	-

**Objectives:** To enable the students to understand the economic theories which may be applied to maximize return and economic environment in which they have to operate

Syllabus		Contact Hours
Unit-1	<b>Introduction:</b> Nature and significance of economics, Goods and Utility, Basic Concept of Demand and Supply, Elasticity of Demand- Price elasticity of Demand, Cross elasticity of Demand, Production - Production Function, Production Process and Factors of Production, Market – Introduction to Monopoly, Perfect Competition, Oligopoly and Monopolistic Competition, Cost Concepts- Opportunity Cost, Total Cost, Average Cost; Marginal Cost; Life Cycle cost, Sunk Cost; Preparation of Cost Sheet Profit Maximisation- numerical problem	7
Unit-2	<b>Money</b> - its evaluation and function, Bank- Commercial Bank and Central Bank and brief idea about function of banking system: Tax and Subsidy, Type of Tax- Direct and Indirect,	4
Unit-3	Monetary and fiscal policy, Inflation and Business cycle, International trade, terms of Trade, Gain from International Trade, Free Trade vs. Protection, Dumping, Balance of Payment	4
Unit-4	<b>Role of Science, Engineering and Technology in Economic Development:</b> Seven salient Feature of the Indian Economy;Inclusive Growth; relevance for the Indian Economy; Iobalisation & opening up of the Indian Economy; GDP- definition and Its measurement; How knowledge of engineering and technology may be used to improve life at slum	6
Unit-5	Green Revolution and White revolution. Reasons for their success and can we replicate them. Appropriate Technology & Sustainable Development. Entrepreneurship: Macro environment for promotion of entrepreneurship: How environment has changed after advent of IT and Globalisation	6
Unit-6	<b>Elementary Economic Analysis:</b> Interest formulas and their Applications, Calculations of economic equivalence, Bases for Comparison of Alternatives: Present Worth Method, Future worth method, Annual equivalent, Internal Rate of Return; Business Risk; Factors which should be taken care while deciding price of the product in the market.	5
	Total	32

Ref	erence Books:
1	G.J. Thuesen, & W.J. Fabrycky, Engineering Economy, Pearson Education, 2007, ISBN 013028128X
2	William G. Sullivan, Elin M. Wicks, C. Patrick Koelling, Engineering Economy,Prentice Hall,( First Indian reprint). 2009, ISBN 0131486497
3	Donald G. Newman, Jerome P. Lavelle & Ted G. Eschenbach, Engineering Economic Analysis, Oxford University Press, USA , 2004, ISBN 0195168070
4	Seema Singh, Economics for Engineering Students, IK International Publishing House Pvt. Ltd, 2014, ISBN 8190777041
5	

CO1	To understand the basic concept of demand and supply, different cost conceps and preparation of cost sheet
CO2	To understand the concept of money, , bank and taxation.
CO3	To understand Monetary and fiscal policy, tradings and dumping concepts
CO4	To knoew the Role of Science, Engineering and Technology in Economic Development in indian economy
CO5	To understand about GDP, GREEN & WHITE revolution.
CO6	To analyze the data to calculate risk, important factor by different methods of economics

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

### **III Year: Sixth Semester**

	CODE: AE302 Title: I C Engines									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ЕТЕ	PRE
3	0	2	4	DCC		15	25	20	40	-

**Objectives:** To understand the basic principle and IC Engine. To know about different components in IC Engine, power generation in IC Engine. To analyze the combustion process in SI and CI engine. To understand and evaluate the auxiliary system in IC engine.

Syllabus		Contact Hours
Unit-1	<b>Introduction to I.C Engines</b> : Principle of working, Classification; Air std. Fuel air and actual cycles, two and four stroke, SI and CI engines main parts, valve and port timing diagram	7
Unit-2	<b>Combustion Phenomenon in SI engines:</b> Principles of combustion in SI engine, effect of engines and operating variables on ignition delay & flame propagation, combustion chamber for SI engines, cycle to cycle variation, pre-ignition, abnormal combustion, theories of detonation, effect of engine and operating variables on detonation, surface ignition, adiabatic flame temperature, ignition systems	7
Unit-3	<b>Combustion phenomenon in CI engines:</b> Principles of combustion in CI engine, delay period, variables affecting delay period, diesel knock, methods of controlling diesel knock, combustion process & combustion chambers for CI engines	7
Unit-4	<b>Fuel system and Mixture requirement in SI and CI Engine:</b> Carburetion- working principles, chemically correct air-fuel ratio and load variation, compensating devices, venture and jet dimension calculation, modern fuel induction system, multi point fuel injection system, fuel injection: common rail direct injection	7
Unit-5	<b>Engine Testing, Supercharging, Lubrication and Engine Cooling:</b> Engine performance and testing, measurement of power, supercharging limits of SI &CI engines methods of supercharging, superchargers, turbo charging, lubrication principles, function of lubricating system, properties of lubricating oil, additives, cooling system, air cooling, water cooling	8
Unit-6	<b>Introduction to Automotive Fuels:</b> Petroleum based fuels and their properties, necessity of alternative fuels, LPG, CNG, producer gas, biogas, H2, biodiesel and alcohols, knock rating of engine fuels	6
	Total	42

Ref	Reference Books:						
1	Funguson, I.C Engines ISBN-13: 978-0471356172						
2	2 Fundamentals of I.C Engines by HN Gupta. ISBN-13: 978-81-203-4680-2						
3	3 Mathew & Sharma, I.C Engines by, Khanna Pub.ISBN, 9383182428.						
4	4 Ganeson, IC Engines TMH, ISBN: 9781259006197						
5							

<b>Course Ou</b>	tcomes
------------------	--------

CO1	To understand basics of IC engines, engine types and their components.
CO2	To understand the power generation phenomenon in ci engines
CO3	To understand the power generation phenomenon in SI engines
CO4	To compare the CI and SI engine indifferent terms like fuels, their rmixtures, To know about CRDI engine
CO5	To analyse the engine performance by testing engine with different additional system like TC, SUPERCHARGER
CO6	To study about different alternate automotive fuels

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	CODE: AE304 Title: Alternative fuels and energy systems									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0	2	4	DCC		15	25	20	40	-

**Objectives:** To understand the need for the alternative fuels and analyze the demand of energy for transportation and Industry, the requirement of fuels for use in IC engine, demand and availability of alternative fuels. To compare alternative fuel with present petro-fuels. To emphasize their advantages and limitations

Syllabus		Contact Hours
Unit-1	<b>Introduction:</b> Estimation of petroleum reserves - need for alternative fuels - availability and suitability to piston engines, Concept of conventional fuels, potential alternative fuels - ethanol, methanol, DEE/DME - hydrogen, LPG, Natural gas, producer gas, bio gas and vegetable oils - use in CI engines-merits and demerits of various fuels.	7
Unit-2	Alcohol Fuels: Properties as engine fuels - performance in SI engines - blends with gasoline and diesel - flexible fuel vehicle - Reformed alcohols - use in CI engines - emulsions	7
Unit-3	<b>Dual fuel systems</b> -spark assisted diesel engines –Surface ignition engines - ignition accelerators - combustion and emission characteristics in engines - emission characteristics.	7
Unit-4	<b>Gaseous Fuels:</b> Hydrogen - properties - use in CI engines-use in SI engines - storage methods - safety precautions. Producer Gas and biogas - raw materials - gasification - properties – cleaning up the gas - use in SI and CI engines, LPG & CNG - properties - use in SI and CI engines	7
Unit-5	<b>Vegetable Oils:</b> Conversion of vegetable oils as biodiesel –production techniques - standards and properties - performance and Emission characteristics, additives	8
Unit-6	<b>Electric and solar powered vehicles:</b> Layout of an electric vehicle- advantage and limitations - specifications - system component. Electronic Control system - high energy and power density batteries - hybrid vehicle - solar powered vehicles.	6
	Total	42

Ref	erence Books:
1	Osamu Hirao and Richard K. Pefley, Present and Future Automotive Fuels, John Wiley and Sons, 1988. ISBN:
	047180259x
2	Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE- Publications, , ISBN 978-0-7680-0052-81990
3	Richard L.Bechtold, Automotive Fuels Guide Book, SAE- Publications, 1997
4	Godfrey Boyle, "Renewable Energy", Oxford University Press, 2004, ISBN: 9780199545339
5	

CO1	To know about alternate fuels availability and suitability to engine
CO2	To understand about blending of fuels.
CO3	To analyze dual fuel system combustion and emission
CO4	To describe gaseous fuels, its production, storage, transportation and safety
CO5	To explain about vegetable oils production techniques - standards and properties - performance and Emission characteristics
CO6	To apply key knowledge of alternate fuel for variety of casestudies.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	CODE: MG302 Title: Fundamentals of management									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0	0	\3	DCC		25	0	25	50	-

**Objectives:** To acquaint the students with the basic concepts of management, necessity to deal with emerging business environment besides sensitizing them about societal challenges

Syllabus		Contact Hours
Unit-1	Definition of management, importance of management, management principals, managerial roles, managerial ethos, management vs administration, managerial functions, task and responsibilities, organizational structure, motivation: meaning, theories and techniques	7
Unit-2	Concept of business environment, corporate social responsibility and corporate governance, managerial values and ethics	7
Unit-3	Objectives and importance of financial management, basics of capital budgeting, cost of capital, emerging sources of funds for new projects, introduction to stock market.	7
Unit-4	Functions of marketing, marketing Vs sales, interface of marketing with other departments, customer life time value, new product development, unethical issues in marketing.	7
Unit-5	Introduction to knowledge management, knowledge society, knowledge economy, building knowledge assets, sources of knowledge, technology innovation process,	8
Unit-6	E-governance: definition, objectives and significance; challenges in Indian context, Digital India programme.	6
	Total	42

Ref	erence Books:
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,
	2011( ISBN:9780273755869)
2	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication, 2005 (ISBN: 8125918523)
3	Management, James A F Stonner, Pearson Education, 2010 (ISBN: 9788131707043)
4	Marketing Management, 14th ed., Philip Kotler, Kevin Lane Keller, Abraham Koshy and MithileswarJha,
	Pearson Education, 2013 (ISBN: 9788131767160)
5	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press, 2013
	ISBN: 9780199691937

CO1	To understand the basics of management ,its principles and its importance
CO2	To understand basic environment ,CSR,ethics and corporate governence
CO3	To know about financial management, stock market and capital budgeting
CO4	To understand knowledge management and technology.
CO5	To know about marketing, its ethics and its its interface with other departments.
CO6	To understand e governance and digital india programmes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE307: Combustion Generated Pollution									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To introduce the students with types fuels, emissions from various engines, exhaust treatment of various engines and instruments used for measuring emissions

	AE307: Combustion Generated Pollution	Contact Hours
Unit-1	Combustion fundamentals: Fuels, alternative fuels for IC engines, Type of hydro carbons. Gasoline specifications. Effect of Engine parameters on performance, fuel injection for SI engines, Engine vehicle road performance, road performance and fuel economy.	8
Unit-2	Emissions and air pollution: Automotive Emissions and their role in air pollution. Photo chemical smog. Chemistry of smog formation. Combustion in Homogeneous mixtures, emission formation. Incomplete combustion, formation of hydro carbons, Carbon monoxide and oxides of nitrogen. Aldehyde emissions.	6
Unit-3	SI engine combustion Emissions: Influence of design and operating variables on gasoline engine exhaust emissions. Hydrocarbon Evaporative Emissions: Various sources and methods of their control. Canisters for controlling evaporative emissions. Emission control systems for gasoline engines: Blow by control closed PCV system design.	6
Unit-4	CI engine combustion Emissions: Sources of emissions during combustion. Effect of air fuel ratio, speed, injection timing on performance and emission formation. D.I and I.D.I engine emissions, smoke emission from diesel engines	8
Unit-5	Exhaust treatment devices: Air injection into exhaust system, Thermal reactors, Catalytic convertor. Stratified charge engines. Honda CVCC engine. Methods of reducing emissions exhaust gas recirculation.	8
Unit-6	Emission Instruments: Non- dispersive Infrared analyzer, Gaschromotograph, flame ionization detector, Chemiluminescent analyzer	6
	Total	42

Ref	eference Books:							
1	B.P. Pundir, Engine emission :, Narose Publication ISBN-13: 978-8184870879							
2	Paul Degoberd, SAE Automobile and air pollution, SAE Publication ISBN 978 07680-6437-7							
3	J.P. Heywood, Fundamentals of I.C. Engines, Tata McGraw Hill Publication. ISBN 13: 9780071004992							

CO1	Student will know about combustion fundamentals, engine performance with fuel economy.
CO2	Student will know about emission formation and its effect on pollution formation.
CO3	Student will know about SI engine combustion Emissions its sources and how to control it.
CO4	Student will know about CI engine combustion Emissions its sources and how to control it.
CO5	Student will know about Exhaust treatment devices (Thermal reactors, Catalytic convertor etc) and EGR
CO6	Student will know about different Emission Instruments.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-309: Operation Research									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course aims to introduce students to use mathematical approach for effective decision making, model formulation and applications that are used in solving business decision problems. After study, the students will be able to solve the real life problems and obtaining the right solution requires understanding and modelling the problem carefully and applying appropriate optimization tool and skills to solve the mathematical models.

	AE-309: Operation Research	Contact Hours
Unit-1	<b>Introduction:</b> Nature, Scope and Historical developments, Linear programming- Model formulation, Graphical and simplex methods, Duality, Degeneracy, sensitivity analysis.	8
Unit-2	<b>Transportation:</b> North-West corner rule, least cost method, VAM, Methods to check the optimality, Assignment- Hungarian method and Sequencing models: Johnson Rule for n- job two-machine, n- job m- machine.	6
Unit-3	<b>Queuing theory :</b> Assumptions and applications of waiting line theory, M/M/1: /FCFS, M/M/K: /FCFS, M/M/K.	6
Unit-4	Game theory and its applications: Pure and mixed strategy, dominance principle, Algebraic, arithmetic, and graphical methods to solve GT problems.	8
Unit-5	<b>Replacement models:</b> Replacement policy for the items that deteriorate over time, replacement policy for the items that deteriorate over time when time value of money is declining, replacement policy for the items that fails suddenly.	8
Unit-6	<b>Network Planning:</b> PERT, CPM, Project crashing, Shortes tpath problem, Maximum flow problem, Minimum spanning tree problem, minimum cost flow problem, Resource levelling.	6
	Total	42

z

Ref	Reference Books:									
1	Operations Research: Theory and Applications by J K Sharma, Macmillan, ISBN: 9780230638853									
2	Operations Research: An introduction by H A Taha, Pearson Education, ISBN: 978-0132555937									
3	Operations Research: Concepts and cases by F S Hiller and G J Liebermaan, TMH, ISBN:0073523453									
4	Quantitative Technique in Management by N D Vohra, TMH, ISBN: 9780070611931									

CO1	To study about history of operation research and learn about linear programming.
CO2	To study about Transportation and different methods of its optimization.
CO3	To study about Queuing theory and its different methods.
CO4	To understand about Game theory and its applications.
CO5	To study about Replacement and its models.
CO6	To study about Network Planning( PERT, CPM, Project crashing etc)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-311: Tyre Technology									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course aims to introduce the students with types of tyres used for different vhicles, design of tyres, manufacturing of tyres and testing of tyres.

	AE-311: Tyre Technology	Contact Hours
Unit-1	<b>Introduction:</b> Importance of tyres, history, current status, functions of pneumatic tyres, applications, types of tyres, desirable tyre properties, classification of tyres based on carcass, tyre profile, geometry, sizing & designation, tyre components, principle of pneumatic tyre, requirements of pneumatic tyres.	8
Unit-2	<b>Tyre Design:</b> General, motion forces, heat build-up, types of bonding, set of service conditions, tyre size requirements, safety requirements: Tread design, general, role of foot print area and factors affecting tread life, various types of tread pattern	6
Unit-3	Carcass design, role of foot print area and factors affecting tread life, various types of tread pattern. Carcass design, role of various fibers used in carcass, estimation of number of piles, Bead design, single bead, multiple beads, and various configurations of wires in bead assembly.	6
Unit-4	<b>Compound Design:</b> General introduction, role of various mixing ingredients, various recipes.	8
Unit-5	<b>Manufacture Technology:</b> Compound mixing, mixing equipment's, extrusion of components, tyre cord, wire cord manufacture, calendaring tyre manufacture, mold procurement, component preparation, green tyre building, pre-curing, curing and post curing operations/treatments.	8
Unit-6	<b>Tyre testing/ Evaluation Methods:</b> General safety standards, carcass strength, resistance to bead unseating, machine simulation test, indoor laboratory testing, field-test on road, proving ground, lates testing techniques.	6
	Total	42

Refe	erence Books:
1	Tyre Technology, S.N. Chakravarty, Indian Rubber Institute
2	Roop S. Bhakuni, Surendra K. Chawla, D. K. Kim,D.Shuttleworth,Tires Cord, Encyclopedia of Chemical Technology, Kirk &Othmer, John Wiley & Sons, 2000
3	E.C. Wood, Pneumatic Tyre Design, W. Heffer, 1952
4	Tire Engineering, Kovac& Rodgers, Goodyear Tire Rubber Co., Ohio 3. Handbook of Rubber Technology, R. Schuster, Wiley Interscience

CO1	To understand about history of tyres, pneumatic tyres, sizing & designation, tyre components.
CO2	To understand aboutTyre Design with its some components
CO3	To understand about Tyre Design with its all components with safety requirements
CO4	To understand about Compound Designandrole of various mixing ingredients,
CO5	To understand about all manufacture technology of tyres.
CO6	To understand abouttyre testing/ evaluation methods with safety standards.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-313: Thermal Engineering									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course introduces students with types of boilers, steam nozzles, types of steam turbines, steam condensers and centrifugal compressors

	AE-313: Thermal Engineering	Contact Hours
Unit-1	<b>Introduction to Boilers:</b> Classification of boilers, boiler mountings and accessories; draft systems, circulation system; combustion and its calculations, and boiler performance.	8
Unit-2	<b>Steam Nozzles:</b> Types of nozzles, flow of steam through nozzles; condition for maximum discharge through nozzle; nozzle efficiency, effect of friction and supersaturated flow through nozzle.	6
Unit-3	<b>Steam Turbines:</b> Working principle and types of steam turbines; velocity diagrams for impulse and reaction turbines, compounding of impulse turbines; optimum velocity ratio and maximum efficiency, blade twisting, comparison of impulse and reaction turbines, condition line and reheat-factor, losses in steam turbines; governing of steam turbines.	6
Unit-4	Steam Condensers: Types and working of condensers, types and performance of cooling towers.	8
Unit-5	<b>Reciprocating Air Compressor:</b> Steady flow analysis, isothermal, adiabatic and polytropic compression; single and multi-stage compression, ideal intermediate pressure; compressor clearance, volumetric and isothermal efficiency; minimum work requirement of a compressor.	8
Unit-6	<b>Centrifugal compressor:</b> Velocity diagrams, efficiency of compressor stage, choice of reaction, stage pressure rise, surging, multi-stage compressor, compressor performance, vaccum pump.	6
	Total	42

Refe	erence Books:
1	P.K. Nag,"EngineeringThermodynamics",Publisher-Tata Mcgraw Hill Publishing Company Limited(ISBN-
	1259062562)
2	Gordon Rogers,"EngineeringThermodynamics",Publisher-Pearson Education( ISBN8131702065
3	Kenneth Wark,"Thermodynamics",Publisher-Mcgraw-hill Book Company(ISBN00706828
4	Gordon Rogers and Yon Mayhew, "Engineering Thermodynamics", PublisherPearsonpublisher(ISBN-978813
5	Van Wylen and Sonntag, "Fundamentals of Classical Thermodynamics", PublisherJohn Wiley & Sons Inc.(ISBN-
	0471041882
6	Moran and Shaprio, "Fundamentals of Engineering Thermodynamics , "PublisherJohn Wiley &
7	Cengel and Boles,"Thermodynamics: An Engineering Approach, "Publisher-The McGraw-Hill Companies(ISBN-
	9789814595292)
8	T.D. Eastop,"Applied Thermodynamics for Engineering Technologists", PublisherLongman publisher(ISBN-
	9788177582383)
9	S. Domkundwar,"Thermal Engineering",Publisher-DhanpatRai& Co (p) Ltd 9(ISBN8177000217)
10	Onkar singh,"AppliedThermodynamics",Publisher- New Age International (p) Limited (ISBN-8122425836)

CO1	To understand about boilers: its types, its components, its calculations, and performance
CO2	To understand about steam nozzles, its types and analysis
CO3	To understand aboutsteam turbines ,its Working principle ,types and analysis.
CO4	To understand aboutTypes and working of condensers& cooling towers with performance.
CO5	To understand aboutreciprocating air compressor and analysis.
CO6	To understand aboutcentrifugal compressor and analysis.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-315: Turbo machinery and gas dynamics											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** This course aims to introduce the student with principles of Turbomachinery, types of turbo devices such as turbines, fans and blowers. This course also offers about the gas dynamics and jet propulsion in engines

	AE-315: Turbo machinery and gas dynamics	Contact Hours
Unit-1	Turbomachinery Principles, Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.	8
Unit-2	<b>Centrifugal Fans and Blowers:</b> Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, Characteristics curves and selection, fan drives and fan noise.	6
Unit-3	<b>Centrifugal And Axial Flow Compressors:</b> Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves. Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple Stage design problems and performance characteristics.	6
Unit-4	<b>Axial And Radial Flow Turbines:</b> Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and Performance characteristics.	8
Unit-5	<b>Gas Dynamics:</b> - Continuity Equation, Momentum Equation, Energy Equation, Stagnation Properties; Isentropic Flow with Variable Area, Wave Motion; Flow with Normal Shock Waves, Oblique Shock Waves, Flow in Constant Area Duct with Friction and With Heat Transfer, Measurement of Fluid Properties, Anemometer, Flow Visualization.	8
Unit-6	<b>Jet Propulsion</b> : -Aircraft Propulsion Theory, Ramjet Engine, Pulsejet Engine; Rocket Propulsion, Liquid Propellant, Solid Propellant, Rocket Propulsion Theory, Rocket Applications, Space Flights.	6
	Total	42

Refe	erence Books:
1	S.M. Yahya, "Fundamentals of Compressible Flow ", John Wiley and Sons Ltd, 1994, ISBN8122403727
2	P.Hill and C. Peterson, "Mechanics and Thermodynamics of Propulsion ", Pearson Education,2009 ISBN0132465485
3	N.J. Zucrow, "Aircraft and Missile Propulsion, Vol. I & II ", John Wiley, 1958, ISBN 1258694360
4	N.J. Zucrow, "Principles of Jet Propulsion and Gas Turbines ", John Wiley, New York, 1957,
5	H.Cohen, G.E.C.Rogers and Saravanamuttoo, "Gas Turbine Theory ", Longman Group Ltd., 1996, ISBN 0582236320
6	A.H.Shapiro, "Dynamics and Thermodynamics of Compressible Fluid Flow Vol. 1 ", John Wiley , 1953, ISBN 0471066915
7	V.Ganesan, "Gas Turbines ", Tata Mcgraw Hill Publishing Co., New Delhi, 2010, ISBN 0070681929,
8	G.P.Sutton, "Rocket Propulsion Elements", John Wiley, 2010, New York, ISBN 0470080248

**Course Outcomes** 

CO1	To study Turbomachinery, fluid machineryand efficiency for compressors and turbines.
CO2	to study centrifugal fans, blowers and its analysis
CO3	To study Axial And Radial Flow Turbinesand its analysis
CO4	To study centrifugal and axial flow compressors and its analysis
CO5	To study gas dynamics
CO6	To study jet propulsion

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-317: Power units and transmission											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** To understand the requirement of Automotive Power Plant. To know the power characteristics of IC engine and other Automotive Power Plants. To analyze the means of power transmission from engine to driving wheels. To know the working of the electrical/hybrid system power transmission

	AE-317: Power units and transmission	Contact
		Hours
Unit-1	<b>Transmission:</b> Introduction, requirements of automobile propulsion and transmission system, Discussion on tractive effort and other performance parameters.	8
Unit-2	<b>Clutch:</b> Need of clutch, types of clutches, construction of clutch systems and clutch plates, operation and torque transmission characteristics. CVT, diaphragm and centrifugal clutch and fluid flywheel.	6
Unit-3	Gear box: Requirements of gearbox, different types of gear boxes viz sliding, constant mesh and Synchromesh, construction details of gear boxes.	6
Unit-4	<b>Hydro-dynamic drive:</b> Fluid coupling, principle and operation 6 torque capacity performance characteristic, torque converter construction, principle of operation, torque capacity, multistage torque converter performance.	8
Unit-5	Automatic transmission: Construction and operating principle, 8 three forward and reverse, four forward and reverse. Over drive unit need and its operation. Hydrostatic drive: construction and operation. Electric drive Ward Leonard control system, construction and operation, advantages and disadvantages.	8
Unit-6	<b>Drive line and Differential:</b> Need and construction of drive line 6 components, universal joints. Need and requirement of differential, principle of operation and construction. Limitations of ordinary differential and concept of limited slip differential.	6
	Total	42

Refe	eference Books:													
1	Crouse W and Anglin D, Automotive Mechanics, Tata McGraw Hill Publication 1td 10thedition 2004 ISBN													
	Number: 0-7680-0708-9													
2	Nakra C P, Basic Automobile, Dhanpat Rai Publication Co. Ltd 7th Edition2005 ISBN, 978-93-5216-040-2													
3	JosepeHeitner Automotive Mechanics – Principle and Practice, East West Press 2nd edition 1999.													
	ISBN:9788176710152 8176710156													
4	Motor Vehicle by Newton, Gerreand Steeds, BH publications. ISBN 9780195699630													

CO1	To understand Transmission and performance parameters
CO2	To understand clutch and its types, construction and characteristics.
CO3	To understand different types of gear boxes and construction details.
CO4	To understand hydro-dynamic drive and its performance.
CO5	To understand Automatic transmission, construction and operation and performance characteristic
CO6	To understand drive line and differential its Need, types and construction

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-319: Computer Simulation of I.C. Engine Process									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To know the basic combustion in IC engine .to learn some relevant simulation softwares. To analyse combustion for the performance parameters. To analyse the combustion for emission .to understand the impact of combustion chamber geometry and other related parameters on combustion in IC engine

	AE-319: Computer Simulation of I.C. Engine Process	Contact Hours
Unit-1	<b>Introduction:</b> Introduction - Heat of Reaction - Measurement of URP- Measurement of HRP - Adiabatic Flame Temperature: Complete Combustion in C/H/O/N Systems, Constant Volume Adiabatic Combustion, Constant Pressure Adiabatic Combustion. Calculation of Adiabatic Flame Temperature - Isentropic Changes of State.	8
Unit-2	<b>Engine Simulation With Air As Working Medium:</b> Deviation 10 Between Actual and Ideal Cycle - Problems, SI Engine Simulation With Adiabatic Combustion, Temperature Drop Due to Fuel Vaporisation, Full Throttle Operation - Efficiency Calculation, Part Throttle Operation, Super Charged Operation.	6
Unit-3	<b>Engine Simulation Fuel Air and actual cycles:</b> Deviation Between 11 Actual and Ideal Cycle - Problems, SI Engine Simulation With Adiabatic Combustion, Temperature Drop Due to Fuel Vaporisation, Full Throttle Operation - Efficiency Calculation, Part-Throttle Operation, Super Charged Operation.	6
Unit-4	<b>Progressive Combustion:</b> SI Engines Simulation With Progressive 10 Combustion With Gas Exchange Process, Heat Transfer Process, Friction Calculation, Compression of Simulated Values, Validation of the Computer Code, Engine Performance Simulation, Pressure Crank Angle Diagram and another Engine Performance. Simulation of 2-Stroke SI Engines.	8
Unit-5	<b>CI Engine Simulation:</b> Mixing of Air & Fuel, Multi Zone Model for Combustion, Different Heat Transfer Models, Equilibrium Calculations, Simulation of Engine Performance, Simulation for Pollution Estimation.	8
Unit-6	<b>SI Engine Simulation:</b> Multi Zone Model for Combustion, Different Heat Transfer Models, Stoichiometric Calculations, Simulation of Engine Performance, Simulation for Pollution Estimation.	6
	Total	42

Refe	erence Books:
1	Ganesan.V. "Computer Simulation of Spark Ignition Engine Process ", Universities Press (I) Ltd, Hyderabad, 1996. ISBN 9780195699630
2	Ramoss.A.L., "Modelling of Internal Combustion Engines Processes ", McGraw Hill Publishing Co., 1992 ISBN 0-76-80-0052-1
3	A shleyCampbel, "Thermodynamic Analysis of Combustion Engines ", John Wiley & Sons, New York, 1986. ISBN-13: 9780898747744
4	Benson.R.S., Whitehouse.N.D., "Internal Combustion Engines ", Pergamon Press, Oxford, 1979 ISBN 13: 9780080227207

CO1	To understand the basics of combustion related measurement and its calculation.
CO2	To understand engine simulation with air as working medium with different cycles and Efficiency
002	
03	To understand Engine Simulation Fuel Air and actual cycles with different cycles and Efficiency
CO4	To understand Engine Performance Simulation2-Stroke SI Engines and Validation of the Computer Code
CO5	To understand CI Engine Simulation for Pollution Estimation
CO6	To understand SI Engine Simulation for Pollution Estimation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

					AE-321: Advanced st	rength of	materia	al		
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-
					•					

**Objectives:** this course introduces the students with theory of elasticity, torsion of non-circular sections, deformation and design of members for fatigue and creep.

	AE-321: Advanced strength of material	Contact Hours
Unit-1	<b>Theory of Elasticity:</b> Plane stress and plane strain problem, strain-displacement relation, stress - strain relations, equilibrium equations, body force, compatibility equations, airy stress function, analysis of simple two dimensional problems in Cartesian coordinates	8
Unit-2	<b>Plates:</b> Bending of circular plates carrying uniformly distributed load over entire surface or with concentrated load at centre, simply supported rectangular plate carrying uniformly distributed (excluding derivation of formulae).	6
Unit-3	<b>Torsion of non-circular section shafts:</b> St. Venant's methods, torsion of shafts of elliptical and rectangular sections, membrance analogy, torsion of shafts of thin tubular section. Laterally loaded columns: Analysis of long columns carrying lateral loads in addition to axial compression eccentrically loaded columns. Beams on Elastic Foundations: Modules of foundation, equation of elastic curve, solution for beams of infinite and semi-infinite length.	6
Unit-4	<b>Deformation beyond elastic limit:</b> Behaviour of material beyond elastic limit, perfectly plastic material, torsion of shafts and analysis of thick cylinders with radial pressure when loaded beyond elastic limit, residual stresses.	8
Unit-5	<b>Curved beams :</b> Theory of curved beams, stresses in curved beams, expression for radius of neutral axis for different cross-sections, C-clamps	6
Unit-6	<b>Miscellaneous Topics:</b> Contact stress in ball and roller bearings, bending of curved tubes, stress analysis of flywheel. Design of members for fatigue and creep: Fatigue behaviour, factors affecting fatigue, mechanics of fatigue failure, fatigue under combined stresses, fatigue life and cumulative fatigue, design formulae for fatigue calculations. Mechanics of creep, relationships regarding creep rate different stresses and temperature, bending of beams at high temperature, stress relaxation in steam turbine bolting, creep under combined stresses, creep analysis of rotating discs	8
	Total	42

Refe	erence Books:
1	E.J. Hearn,"Mechanics of Materials: v. 2: An Introduction to the Mechanics of Elastic and Plastic Deformation of
	Solids and Structural Components", PublisherELSEVIER, New Delhi, 2008(ISBN-8131214567)
2	Timoshenko,"Strength of Materials: vol. 2 ",Publisher-CBS Publishers & Distributors, 2002(ISBN-8123910770)
3	L S Srinath, Advanced Mechanics of Solids, 3rd Edition, McGraw-Hill, 2009.
4	S P Timoshenko and J N Goodier, Theory of Elasticity, 3rd Edition, Tata McGraw-Hill Edition, 2010
CO1	To Understand basics of elasticity and its related problems.
-----	--
CO2	To study bending of plates with different loadings.
CO3	To studytorsion of non-circular section shafts, Analysis of long columns carrying lateral loads and Beams on Elastic Foundations
CO4	To study perfectly plastic material, torsion of shafts and analysis of thick cylinders
CO5	To studyMechanics of wire drawing, tube drawing and forging process
CO6	To study of creep, fatigue, stress analysis of flywheel.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE323: Finite Element Methods and Applications											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** To introduce the student with fundamentals of finite element method, Parametric element stresses and strains, application of FEM in various mechanical field and use a software to perform analysis.

	AE323: Finite Element Methods and Applications	Contact Hours
	Fundamental concepts of the Finite Element Method. One Dimensional Problem (Bar of uniform and variable cross sections), The Galerkin Approach, The potential –Energy Approach, shape	8
Unit-1	Functions, Derivation of stiffness matrix and load vector for the element and for the entire domain. Evaluation of displacement, stresses and reaction forces.	
Unit-2	Trusses: Introduction, Plane Trusses, Local and Global coordinate Systems, Element Stiffness Matrix and Stress calculations	6
Unit-3	Beam Elements-Analysis of Beams and Frames: Beam elements, Reduced integration, Elements based on Bernoulli and Timoshenko theory of beams Two –Dimensional problem using Constant strain triangles (CST), Two dimensional isoparametric elements and numerical integration, element stiffness matrix, Force vector. Three dimensional element.	8
Unit-4	Heat Transfer <i>and</i> Fluid Flow: Steady state heat transfer, heat conduction governing equation, boundary conditions, Functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, Basic differential equation for fluid flow in pipes and around solid bodies.	8
Unit-5	Dynamic analysis: Element mass matrices, Evaluation of Eigenvalues and Eigenvectors.	6
Unit-6	Electromagnetic simulation using FEM. Application of finite element method to electrical systems. Use of Softwares such as MAT LAB/ABAQUS/ANSYS/ NASTRAN/IDEAS. Basic feature of these softwares.	6
	Total	42

Ref	erence Books:
1	Finite Element Procedures, K.J. Bathe, Prentice Hall of India.
2	Finite Elements in Engineering by Chandrupatla and Belegundu.
3	Finite element Method by J.N.Reddy.
4	Finite element Method, O.C. Zienkiewicz& R.A. Taylor
5	Finite element Analysis, C.S. Krishnamurthy
6	Finite element Method, Kenneth H. Hubener
7	Finite Element Method, Desai & Abel

CO1	To understand Fundamental concepts of the Finite Element Method.
CO2	To understand ISO parametric elements Element stresses and strains.
CO3	To understand Derivation of force and displacement vectors for the entire domain. Boundary conditions, Solution of the overall problems
CO4	To understand Applications of finite element method to various field problems
CO5	To understand Use of Software such as ANSYS/ NASTRAN/IDEAS.
CO6	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-306: Automotive Aerodynamics & CFD											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** To introduce the student with aerodynamics, computational fluid dynamics, styling of vehicles, heat management of engines and wind tunnel testings

	AE-306: Automotive Aerodynamics & CFD	Contact Hours
Unit-1	Aerodynamics for Automobiles - Fluid Properties, Fluid Statics, Measurement of Pressure, Fluid Kinematics, Fluid Dynamics, Euler and Bernoulli Equations, Ns Equations, Dimensional Analysis and Similitude, Viscous Flow, Flow Over Immersed Bodies, Boundary Layer, Production of Lift and Drag, Effect of Aerodynamic Forces on Stability of the Vehicle.	8
Unit-2	Computational Fluid Dynamics - Fundamentals of CFD Basics of Finite Difference and Finite Volume Methods, Boundary Conditions, Initial Conditions, Choice of Turbulence Models, Merits And Limitations of Commercial CFD Tools.	6
Unit-3	Aerodynamic Styling of Vehicles - Effect of Shape and Size of Various Exterior Parts of the Vehicle on the Drag Force, Details of Effect of Shape on Aerodynamics of Various Vehicles: Passenger Car, SUV, Utility Van, Mini Bus, Bus, Cargo, Truck and Towing Vehicle Aerodynamics of Race Cars- AE-Rodynamic Features of Race Cars, Measures to Create Negative Lift, Front and Rear Wings, Stability Consideration, Fluid Flow Over Brakes.	6
Unit-4	Thermal Management in Vehicles - Engine Cooling Requirements, Underhood Cooling, Mechanism of Drag Production by the Cooling System.	8
Unit-5	Experimental Procedure and Facilities - Basics of Wind Tunnels, Types of Wind Tunnels, Instrumentation for Wind Tunnels: Pressure Measurement, Velocity Measurement, Force and Moment Measurement Devices, Flow Visualization, Case Studies of Different Wind Tunnels Used for Vehicle Aerodynamics Experimentation.	8
Unit-6	Aerodynamics for Automobiles - Fluid Properties, Fluid Statics, Measurement of Pressure, Fluid Kinematics, Fluid Dynamics, Euler and Bernoulli Equations, Ns Equations, Dimensional Analysis and Similitude, Viscous Flow, Flow Over Immersed Bodies, Boundary Layer, Production of Lift and Drag, Effect of Aerodynamic Forces on Stability of the Vehicle.	6
	Total	42

Refe	erence Books:
1	Bruce R. Munson, Donald F. Young, Theodore H. Okishi, Fundamentals of Fluid Mechanics, 4th Edition, John
	Wiley and Sons Inc, 2005, ISBN 0471675822
2	John F. Doughlas, Janusz M. Gasiorek, John A. Swaffield, , Fluid Mechanics, 5th Edition, Prentice Hall, 2006,
	ISBN 0131292935
3	Hucho W. H., Aerodynamics of Road Vehicles, 4th Edition, SAE- International, 2005, ISBN 0768000297
4	Joseph Katz, Race Car Aerodynamics, Robert Bentley Publishers, Cambridge, 1995, ISBN 0837601428
5	Barnard R.H., Road Vehicle Aerodynamic Design: An Introduction, Mechaero Publishing, March 2010, ISBN
	0954073479
6.	Jewel B. Barlow, Willium H. RAE, Alan Pope, Low Speed Wind Tunnel Testing, 3rd Edition, Wiley Interscience,
	1999, ISBN 0471557749
7	Holman J.P., Heat Transfer, 8th Edition, Mc Graw Hill Company, Uk, 2001, ISBN 0072406550
8	Steven Daly, Automotive Air-Conditioning and Climate Control Systems, Butterworth Heinemann, May, 2006,
	ISBN 0750669551

CO1	To study of basics of Aerodynamics for Automobiles
CO2	To study Fundamentals of CFD Basics of Finite Difference and Finite Volume Methods
CO3	To study Aerodynamic Styling of Vehicles and of Effect of Shape on Aerodynamics of Various Vehicles
CO4	To study Thermal Management in Vehicles - Engine Cooling and Underhood Cooling, Mechanism of Drag Production by the Cooling System
CO5	To study Wind Tunnels, its Types and is Instrumentation with case studies.
CO6	To study Fluid, Fluid Dynamics, Production of Lift and Drag, Stability of the Vehicle.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-308: Advanced Manufacturing Technology									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course aims to understand the functioning of new machining processes working on principle of non-thermal energy, Electro-chemical machines, laser beam machines, fabrication of semiconductors

	AE-308: Advanced Manufacturing Technology	Contact
	<b>NEWER MACHINING PROCESSES</b> (Non-thermal energy) – Abrasive machining – water jet machining – ultrasonic machining – construction working principle – steps - types – process	Hours 8
Unit-1	parameters – derivations – problems, merits, demerits and applications.	
	NEWER MACHINING PROCESS – Wire cut EDM – ECG - Electric discharge machining –	6
Unit-2	construction – principle – types – control - circuits – tool design – merits, demerits & applications.	
	NEWER MACHINING PROCESS – Laser beam machining – Electron beam machining –	6
Unit-3	Plasma arc machining – Ion beam machining – construction working principle types – process parameter – derivations – problems, merits, demerits and applications.	
Unit-4	- <b>NEWER MACHINING PROCESS</b> chemical machining – electro chemical machining- construction – principle – types – control - circuits – tool design – merits, demerits & applications	8
	FABRICATION OF MICRO DEVICES Semiconductors – films and film depurification –	
Unit-5	Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication.	8
	MICROFABRICATION TECHNOLOGY Wafer preparation - monolithic processing -	6
Unit-6	moulding – PCB board hybrid & mcm technology – programmable devices & ASIC – electronic material and processing. –steriolithography SAW devices, Surface Mount Technology	
	Total	42

Refe	erence Books:
1	SeropeKalpakjian& Steven Schmid- Manufacturing Processes for Engineering Materials (5th Edition)-
	2003,ISBN-13: 978-0132272711/ISBN-10: 0132272717
2	Julian W. Gardner,"Micro sensors Mems & smart devices—2002", Wiley-Blackwell, ISBN-13: 978-0471861096
3	Grahem T. Smith, "Advanced machining", I.F.S. UK 1989, ISBN-10: 0903608952/ ISBN-13: 978-0903608954
4	Jaeger R.C., "Introduction to microelectronic fabrication", Addison Wesley, 1988., ISBN-10: 0201444941/ISBN-
	13: 978-0201444940

CO1	To study newer machining processes(Abrasive machining – WJM - USM,CHM – ECM) with all details
CO2	To study newer machining processes(EDM, ,W EDM,) with all details
CO3	To study newer machining processes(LBM,EBM,PAM,IBM,) with all details
CO4	To study fabrication of micro devices semiconductors in detail
CO5	To study microfabrication technology with processing and technology
CO6	To study newer machining processes(ECDM, ECM) with all details

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-310: Quality Management & Six Sigma Applications									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To familiarize the student with quality, statistical control of processes, sampling process, ISO standards for six sigma quality, life testing and reliability design

	AE-310: Quality Management & Six Sigma Applications	Contact Hours
Unit-1	<b>Introduction to Quality:</b> Definition of Quality- product, user, value, and manufacturing based perspectives, Dimensions of Quality, Quality Planning, Quality costs- optimization of quality costs, seven tools of quality control; Philosophies of Quality Gurus- Deming, Juran, Crosby, Feigenbaum, Ishikawa, Taguchi. Comparison of Quality Philosophies.	8
Unit-2	<b>Statistical Process Control:</b> Introduction to Quality characteristics- variables and attributes, Types and causes of variations, Control Charts for variables and attributes, Process capability.	6
Unit-3	Acceptance Sampling: Sampling process and lots formation; Advantages and applications of acceptance sampling; characteristics of O.C. Curve; Single, double, multiple, sequential sampling; ASN, ATI, AOQL, AOQ, AQL, LQL, Producer's and Consumer's risks.	6
Unit-4	Six Sigma and ISO 9000:2000: Principles of Six Sigma, Statistical basis, Tools and techniques, DMAIC principle, application of six sigma in manufacturing and service organizations, structure of ISO standards, Factors leading toISO, Implementation and registration, Benefits of ISO.	8
Unit-5	Life Testing-Reliability: Life testing: objective, failure data analysis, MTTF, MTBF, hazard rate, exponential and Weibull models, system reliability-series, parallel and mixed configurations, Markov model.	8
Unit-6	<b>Reliability Design and Allocation:</b> Design for reliability, reliability improvement techniques, active redundancy and standby redundancy, K-out-of-N redundancy and maintenance policies.	6
	Total	42

Refe	erence Books:
1	J R Evans and W M, "Lindsay The Management and Control of Quality", Cengage learning, India, ISBN-10:
	0538452609/ISBN-13: 978-0538452601
2	KanishkaBedi," Quality Management Oxford higher education", Oxford University Press, 2006, ISBN
	0195677951, 9780195677959
3	Besterfield, "Total Quality Management", Pearson Education India, 2011, ISBN 8131732274, 9788131732274
4	F M Gryna, R C H Chua, J A DefeoJura," Quality Planning and Analysis for Enterprise Quality", Tata McGraw-
	Hill, ISBN-10: 0072966629ISBN-13: 978- 0072966626

Course	Outcomes
CO1	To understand the concept of quality, Quality costs and Philosophies of Quality
CO2	To understand Process Controlin Statistical way and Process capability.
CO3	To understand Sampling process and lots formationProducer's and Consumer's risks.
CO4	To understand Principles of Six Sigmaand ISO 9000:2000standard
CO5	To understand the life testing-reliability life different configuration and models.
CO6	Student will able to do reliability Design and Allocation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-312: Metrology									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course aims to introduce the student with principles of measurement, types of standards, limits, fits, tolerances; measurement of angle, screw threads, gear measurement and testing on machines.

	AE-312: Metrology	Contact Hours
Unit-1	<b>Principles of measurement:</b> Definition of Metrology, difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors, application of Least Square principles, errors in measurement of a quality which is function of other variables. Length Standards: Line standards, end standards and wavelength standards, transfer from line standards to end standards. Numerical based on-line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges. Limits, fits and tolerances: Various definitions, IS9191963, different types of fits and methods to provide these fits. Numerical to calculate the limits, fits and tolerances as per IS 919-1993. ISO system of limits and fits; Gauges and its types, limit gauges – plug and ring gauges. Gauge Design – Taylor's Principle, wear allowance on gauges. Different methods of giving tolerances on gauges,	8
Unit-2	<b>Comparators:</b> Characteristics, Uses, Limitation, Advantages and Disadvantages. Mechanical Comparators: Johanson Mikrokator and Sigma Mechanical Comparator. Mechanical - optical comparator. Electrical and electronic comparators. Pneumatic comparators – Systems of Penumatic gauging: Flow type and back pressure type, different type of sensitivities and overall magnification. Solex Pneumatic gauge and differential comparators.	6
Unit-3	<b>Angular Measurement:</b> Sine Bar – different types of sine bars, use of sine bars in conjuction with slip gauges, precautions and calibration of sine bars. Use of angle gauges, spirit level, errors in use of sine bars. Numerical. Principle and working of Microoptic autocollimator. Circular Division: dividing head and circular tables, circular division by precision Polygons. Caliper Principle, Calibration of polygons. Numerical based on circular division. Straightness and flatness: Definition of Straightness and Flatness error. Determination of straightness error of straight edge with the help of spirit level and auto collimator. Numericals	6
Unit-4	<b>Screw Thread Measurement:</b> Errors in threads, Measurement of elements of screw threads – major diameter, minor diameter, pitch, flank angle and effective diameter (Two and three wire methods). Effect of errors in pitch and flank angles and its mathematical derivation.	8
Unit-5	<b>Gear Measurement:</b> Measurement of tooth thickness – Gear tooth Verniercaliper, Constant chord method, base tangent method and derivation of mathematical formulae for each method. Test plugs method for checking pitch diameter and tooth spacing. Measurement of Gear Pitch, Parkinson Gear	8
Unit-6	<b>Machine Tool Alignment:</b> Machine tool tests and alignment tests on lathe. Alignment tests on milling machine. Alignment tests on a radial drilling machine. Interferometry: Principle of measurement, Interferometry applied to flatness testing, surface contour tests, optical flats, testing of parallelism of a surface with the help of optical flat. Quantitative estimate of error in parallelism, Flatness Interferometer NPL-Gauge length interferometer for checking the error in slip gauges. Numericals based on Interferometry. Surface texture: Introduction, different types of irregularities, standard measures for assessment and measurement of surface finish.	6
	Total	42

Refe	erence Books:
1	R.K. Jain, "Engineering Metrology", Khanna Publishers, Delhi, BN 10: 817409153X ISBN 13: 9788174091536
2	I.C. Gupta, "Engineering Metrology", DhanpatRai Publications, Delhi, ISBN-10- 8189928457
3	F.W. Galyer& C.R. Shotbolt, "Metrology for Engineers", ELBS edition., ISBN-10: 0304318442/ISBN-13: 978-
	0304318445
4	R. Jenkins, "Fundamentals of Mechanical Inspection", Tata, McGraw Hill,
5	C. Dotson, R. Harlow, R. Thompson, "Fundamentals of Dimensional Metrology", Thomson Asia Pte Ltd.,
	Singapore 6. A.S.T.M.E., "Handbook of Industrial Metrology", Prentice Hall, ISBN-10: 1418020621ISBN-13:
	978-1418020620

CO1	To understand Principles of measurement, standards, measuring instruments.
CO2	To understand comparators and its types with comparison
CO3	To understand angular measuring instruments and its error calculations
CO4	To understand screw thread measuring methods and its error
CO5	To understand Gear measuring methods.
CO6	To understand Machine Tool Alignment and quantitative analysis of errors.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

					AE-314: Advances in V	Velding	& Casti	ng		
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

Objectives: To familiarize the students with the advances in welding and casting technology

		Contact
	AE-314: Advances in Welding & Casting	Contact
Unit-1	<b>CASTING DESIGN Heat transfer between metal and mould</b> — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering system.	8
Unit-2	<b>CASTING METALLURGY Solidification of pure metal and alloys</b> – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel, Cast Iron, Al alloys, Babbit alloy and Cu alloy.	6
Unit-3	<b>RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT</b> Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry – Computer aided design of casting.	6
Unit-4	WELDING METALLURGYAND DESIGN Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminium, Mg, Cu, Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control. Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.	8
Unit-5	<b>RECENT TRENDS IN WELDING</b> Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering.	8
Unit-6	Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.	6
	Total	42

Refe	erence Books:
1	ASM Handbook, Vol 15, Casting, ASM International, 2004, ISBN 978-0871707116
2	ASM Handbook vol.6, welding Brazing & Soldering, ASM International, 2003, ISBN 978-0871703828
3	Parmer R.S., Welding Engineering and Technology, Khanna Publishers, 2002, ISBN 9788174090287
4	Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002, ISBN 8174091599
5	HEINE, LOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2001, ISBN 0070993483
6.	Jain P.L., Principles of Foundry Technology, TataMcGrawHill Publishers, 2003, ISBN 0070447608
7	Howard B. Cary, Scott C. Helzer, Modern Welding Technology, Pearson Prentice Hall Pvt Ltd., 2011, ISBN
	0131836919
8	J. Piotrowski, W. Randolph, Robotic welding – A guide to selection and application, Society of Manufacturing,
	1987, ISBN 0872632660
9	CORNU.J. Advanced welding systems – Volumes I, II and III, Springer Publishing, 2013, ISBN 3662110512
10	LANCASTER.J.F., Metallurgy of welding, Springer Publishing, 1987, ISBN 0046690107

CO1	To understand Design considerations in casting
CO2	To understand the solidification of casting of different metals.
CO3	To understand recent trends in different types of casting and foundry layouts
CO4	To understand welding in terms of metallurgy and its design to minimize defects.
CO5	To understand recent trends in different types of welding.
CO6	To understand automation of welding in different environment.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-316: Materials for automobile components									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course aims to introduce the students with composites used for automobile components, types of composite material, constituents material used for composites and failure theories for composites

	AE-316: Materials for automobile components	Contact Hours
	Introduction to Composites: Introduction and Concept, Historical Development, materials used	8
<b>T</b> T <b>1 1</b>	for manufacturing automobile components, Concept of Composite Materials, Material Properties	
Unit-1	Improved by Forming, a Composite Material& Its engineering potential, materials	
	Basic Definitions and Classification of Composites: Definitions, Types of Composites,	6
	Classification Based on Matrix Material: Organic Matrix Composites Polymer Matrix Composites	
TI:4 0	(PMC), Carbon Matrix Composites Or Carbon Carbon Composites, Metal Matrix Composites	
Unit-2	(MMC), Ceramic Matrix Composites (CMC); Classification Based on Reinforcements: Fiber	
	Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites,	
	Particulate Composites	
	Advantages of Composites Materials: Comparison with Metals, Advantages & Limitations of	6
Unit-3	Composites	
	Manufacturing: Lay up and curing - open and closed mould processing, Hand lay, Up techniques,	8
Unit-4	Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding,	
	Cutting, Machining and joining, tooling, Quality assurance, Introduction, material qualification,	
	Types of defects, NDT methods.	
	Comparison of Failure Theories Design Concepts: Design Issues Typical Structural Component	
Unit-5	Design Process Laminate Analysis/Design Software Composite Codes & Standards Manufacturing	8
	Processes Processing of Composite Materials Overall Considerations, Autoclave Curing, Other	
	Manufacturing Processes Fiber-only Performs, Combined Fiber-Matrix Perform. Manufacturing	
	Techniques: Tooling and Specialty Materials, Release Agents, Peel Plies, Release Films and	
	Fabrics, Bleeder and Breather Plies, Bagging Films	
	<b>Special Topics :</b> Testing of Composites (ENGN4511) Mechanical Testing of Composites,	6
Unit-6	Tensile Testing, Compressive Testing, Intra- 84 Laminar Shear Testing, InterLaminar Shear Testing, Eracture Testing, Etc. Environmental Effects on Composites Micromechanics of	
	Laminae Engineering Applications General Engineering Applications of FRP Composites	
	Applications Related to Aerospace, Automobile, Bridge and Other Civil Engineering Structures,	
	Câse Studies	
	Total	42

Refe	erence Books:
1	Adanced Composite Materials for Automotive Applications : Structural Integrity and Crashworthiness/Ahmed
	Elmarakbi / John Wiley & Sons, 2013 / 111853526X, 9781118535264
2	Mechanics of Fibrous Composites / Carl T. Herakovich / Wiley, 1997 / 0471106364, 9780471106364

CO1	To understand Historical Development. Concept of Composite Materials
001	
CO2	To understand different types of composites
002	To understand different types of composites.
CO3	To understand composite and its comparison to metals.
	r i i i r i i i i i i i i i i i i i i i
CO4	To understand mechanics in composites, its constituents role in design
04	To understand meenanes in composites, its constituents fore in design.
005	
COS	I o understand theories of failure and design concept for composite manufacturing.
CO6	To understand Mechanical Testing of Composites
200	To understandario entanti a composites.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-318: Tribology and lubrication										
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE	
3	0/1	2/0	4	DEC		15	25	20	40	_	

**Objectives:** This course aims to introduce student with general parameters for surface interaction, adhesive wear, friction between surfaces and lubrication's

	AE-318: Tribology and lubrication	Contact Hours
Unit-1	<b>Introduction:</b> Surface interactions, science of rubbing surface, general consideration of parameters involved, wear rate, modeling and solution of simple problems	8
Unit-2	<b>Material properties influencing interactions:</b> Introduction, elastic properties, Plastic deformation properties, relation between the strength and other Properties of solids, chemical reactivity of surfaces, absorbed surface layer, Surface energy, relation between surface energy and hardness, Surface Interfacial Energies of Solids under engineering condition	6
Unit-3	<b>Surface Interaction:</b> Size of real contact area and effect of surface energy, size of junction, rheologial properties, Wear in tribological joints - classification, calculation methods with allowance for stiffness, wear limits, reliability of joints, simple examples, detailed study of manufacturing methods for highly reliable joints. Economic role of wear, measurement, types, and use of radiotracer techniques	6
Unit-4	Adhesive wear: Mechanism, size, shapes of transferred and wear particles, quantitative laws, equilibrium calculation of fragments under different conditions, minimum load for loose particle formation, Quantitative expression for abrasive wear, of hardness and particle size on abrasive wear rate, surface fatigue wear, brittle fracture wear, corrosive wear with types	8
Unit-5	<b>Friction:</b> Introduction, laws, function, properties of uncontaminated metals in air, outgassed metal surface, calculation of flash temperature using surface energy, stick slip and its prevention	8
Unit-6	<b>Lubrication:</b> Solid film lubrication, boundary lubrication with single and multiple penetration models, properties of lubricants, effectiveness of lubrication-intermediate temperature, behavior of a solid lubrication below melting point effect of speed, load on lubrication. Lubricants, their properties lubrication technique in vacuum, lubricant coating and its stability. Theory of electrohydrodynamic lubrication film thickness, frictional stress heat flow & temperature, service life of roller bearings	6
	Total	42

Ref	Reference Books:								
1	Gwidon, Stachowiak, Engineering Tribology 2005 Edition, Publisher-Elsevier (ISBN - 13: 9780123970473)								
2	GwidonStachowiak;Experimental Methods in Tribology Publisher-Elsevier (ISBN -13: 9780444515896)								
3	John Williams, Engineering Tribology OUP Publisher: Cambridge University Press (ISBN-13: 9780521609883)								

CO1	To understand basics of tribology and lubrication with its parameters.
CO2	To understand material properties influencing interactions.
CO3	To understand rheological properties and Wear in tribological joint.
CO4	To understand Quantitative expression for abrasive wear
CO5	To understand Friction and its stick slip and its prevention
CO6	To understand lubrication, lubricant, film thickness and service life of bearing.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-320: Reliability & Maintenance Engineering										
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE	
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-	

**Objectives:** This course is designed to introduce the student with mathematics of reliability, system reliability assessment, availability and maintainability.

	AE-320: Reliability & Maintenance Engineering	Contact Hours
Unit-1	<b>Introduction and Reliability Mathematics :</b> Relevance of reliability, availability and maintainability, definition of reliability, factors influencing system effectiveness, laws of probability, probability distributions; exponential Weibull normal, log normal, data collection recovery of data, Statistical analysis of failure data	8
Unit-2	<b>Fundamentals Of Reliability :</b> Various reliability related functions; probability density function, cumulative distribution function, reliability function and hazard rate; reliability models; constant rate, Weibull, normal and lognormal model	6
Unit-3	<b>System Reliability Assessment :</b> Types of systems- series, parallel, series-parallel, parallel-series, stand by and complex; method of reliability evaluation; cut set and tie set methods, event trees and fault trees methods, markov method, Reliability of repairable systems	6
Unit-4	<b>Reliability Improvements :</b> Methods of reliability improvements,; low level and high level redundancy, active , stand by and K-out-of-N redundancy, effect of maintenance	8
Unit-5	<b>Availability and Maintainability Assessments:</b> Point, mission and steady state availability. Availability assessment, Maintainability and its assessment. Maintenance policies	8
Unit-6	<b>Design for Reliability :</b> Reliability allocation, Design for reliability and maintainability, optimization of reliability and maintainability and their trade-off, Practical applications of RAM Engineering to systems, products and processes., Monte Carlo simulation	6
	Total	42

Refe	erence Books:
1	Ebeling CharlesE.,"An introduction to Reliability and Maintainability Engineering", Publisher: Tata McGraw-Hill
	Publishing Co. Ltd., New Delhi (ISBN-13: 9780070188525), 1996
2	Srinath,L.S." Reliability Engineering", PUBLISHER : Affiliated East – West Press Ltd., New Delhi(ISBN: 978-
	81-317-2121-6),1991
3	Dhillon,B.S.,"EngineeringMaintainbility",PUBLISHER: Prentice Hall of India, New Delhi(ISBN:
	9780080505688),1991
4	Blanchard, Benjamin, S., "Logistics Engineering and Management", PUBLISHER: Prentice Hall of India, New
	Delhi(ISBN: 9780131246997),2004

CO1	To understand reliability, availability and maintainability and its probability distributions.
CO2	To understand fundamentals of reliability
CO3	To understand Types of systems, reliability evaluation methods.
CO4	To understand different Methods of reliability improvements.
CO5	To understand availability, maintainability, Maintenance policies and steady state availability
CO6	To understand Design for reliability.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-322: Elastic & Plastic Behaviour of Materials										
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE	
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-	

Objective: To familiarize the students with basics of state of stress and strain, in three dimensions, Yield criteria, forming processes, forging, rolling, wire drawing. To impart in-depth knowledge of real-life application Sheet metal forming operations, Sheet metal cutting operations like blanking, shearing and laser cutting and its force analysis, bending and spring back, die design for deep drawing and bending

	AE-322: Elastic & Plastic Behaviour of Materials	Contact Hours
Unit-1	<b>Introduction:</b> Stress and strain tensor, three invariants, transformation rules, equilibrium equations, Study of stress-strain diagrams of various materials under states of tensile, compressive, shearing and bending stress.	8
Unit-2	<b>Basic theory of elasticity:</b> Constitutive law, Generalized Hooke's law, work of elastic deformation, plane stress and plane strain conditions, simple shear, elastic change in volume and shape, specific work of elastic deformation	6
Unit-3	<b>Fundamentals of plastic deformation:</b> General information about structure of metals, single crystal and its deformation, geometry and movement of dislocations, Burger's vectors, circuits and dislocation loops, deformation of metals: slip and twinning, effect of hot and cold working on properties of metals. Micro and macro hardness tests, Erichsen cupping test, Limit dome height test, forming limit diagram.	6
	hardening and discontinuous yielding, combined stress states, yield locus, anisotropy in yielding, yield surface and normality, Octahedral shear stress and shear strain, plastic stress-strain relations.	
Unit-4	<b>Fracture:</b> Study of ductile and Brittle fractures, Griffith theory of brittle fracture, ductile fracture, ductile - Brittle transition behaviour, notch effect and notch sensitivity, effect of hydrostatic pressure on fracture and methods of protection against fracture. Strain energy release rate, stress intensity factor, fracture toughness and design, plane strain toughness testing, plasticity corrections, Crack opening displacement, J-integral.	8
Unit-5	<b>Fatigue:</b> Stress cycles, the nature of fatigue: low cycle and high cycle fatigue, S-N curve, mechanism of fatigue, fatigue strength of metals and statistical nature of fatigue, effect of mean stress on fatigue, strain life equations, fatigue crack propagation, stress concentration, size and surface effects on fatigue, fatigue failure under combined stress, cumulative fatigue damage due to varying amplitude of stress, other factors affecting fatigue strength, local strain approach.	8
Unit-6	<b>Creep:</b> Time dependent mechanical behaviour, creep curve, design curves, Constant-temperature creep tests, mechanism of creep rupture: dislocation, diffusion and grain boundary sliding, deformation mechanism maps, activation energy for steady state creep, empirical relation for creep behavior, plastic flow rules for creep, metallurgical factors affecting creep behaviour, selection of creep resistant materials and applications.	6
	Total	42

Ref	erence Books:
1	Mechanical metallurgy, George E. Dieter, 1988, Mc Graw Hill, New York, ISBN-0071004068.
2	Metal forming- Mechanics and Metallurgy. Hosford, W.F., Cadell, R. M., 2007. Cambridge University Press, ISBN-
	0521881218.
3	Dislocations and mechanical behaviour of materials, Shetty, M.N., 2013, PHI Learning, New Delhi, ISBN-
	9788120346383.

CO1	Describe the elastic and plastic behaviour from stress-strain curves for materials;
CO2	Recognize typical plastic yield criteria established in constitutive modeling;
CO3	Understand the physical interpretation of material constants in mathematical formulation of constitutive relationship;
CO4	Analyze theories of failure and design components for safe operation.
CO5	Develop constitutive models based on experimental results on material behavior.
CO6	Examine the properties of ideally plastic solid and apply the concepts of energy methods in solving structural problems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	2	1	1	1	1	2	2	1	3
CO2	3	3	2	2	2	2	2	1	1	1	1	3	3	2	2
CO3	3	3	3	2	2	2	1	1	1	1	1	2	2	1	3
CO4	3	3	3	3	2	2	2	1	1	1	1	2	3	1	2
CO5	3	3	3	3	3	2	2	1	1	1	1	3	3	2	3
CO6	3	3	3	3	3	2	2	2	1	1	1	2	3	2	3

	AE-324: Production Planning & Inventory Control									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

Objectives: To familiarize the students with the production planning and inventory control system

Syllabus		Contact
•		Hours
	INTRODUCTION Objectives and benefits of planning and control- Functions of production control-Types of production-job- batch and continuous-Product development and design-	8
Unit-1	Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect	
	aesthetic aspect. Profit consideration-Standardization, Simplification & specialization-Break even	
	analysis-Economics of a new design	
Unit 2	WORK STUDY Method study, basic procedure-Selection-Recording of process - Critical analysis,	6
Unit-2	Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis	
	from standard data - Predetermined motion time standards	
	PRODUCT PLANNING Product planning-Extending the original product information-Value	6
Unit-3	analysis-Problems infack of product planning	
	PROCESS PLANNING Process planning and routing-Pre requisite information needed for process	8
Unit-4	planning-Steps in process planning-Quantity determination in batch production Machine capacity,	
	balancing-Analysis of process capabilities in a multiproduct system	
	PRODUCTION SCHEDULING Production Control Systems-Loading and scheduling-Master Scheduling Scheduling rules Contt charts Dernetual Loading Pasia scheduling problems. Line of	7
Unit-5	balance – 90 Flow production scheduling-Batch production scheduling-Product sequencing –	,
	Production Control Systems-Periodic batch control Material requirement planning kanban –	
	Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning	
	completion times and due dates	
	INVENTORY CONTROL AND RECENT TRENDS IN PPC Inventory control-Purpose of	7
Unit-6	holding stock-Effect of demand on inventories Ordering procedures. Two bin system -Ordering	
	cycle system Determination of Economic order quantity and economic lot size-ABC analysis-	
	Recorder Procedure-Introduction to computer integrated production planning systems-elements of	
	JUST IN TIMESTSTEM Fundamentals of MKP II and EKP	12
	10(4)	44

Refe	erence Books:
1	MartandTelsang" Industrial Engineering and Production Management", PublisherS. Chandand Company, First
	edition, 2000 (ISBN 812191
2	James.B.Dilworth" Operations management - Design, Planning and Control for manufacturing and services"
	Mcgraw Hill International edition1992
3	Samson Eilon, "Elements of production planning and control", , Publisher- Universal BookCorpn.1984 (ISBN 13:
	9780023318009)
4	Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", Publisher 8th Ed. John
	Wiley and Sons, 2000 (ISBN 13: 9780471056720)
5	Melynk, Denzler," Operations management – A value driven approach" Publisher Irwin Mcgrawhill (ISBN -13:
	9780256123814)

CO1	To understand basics of Production its types, Product development and design
CO2	To understand work study and Method study
CO3	To understand product planning.
CO4	To understand Loading and scheduling
CO5	To understand Process planning and routing
CO6	To understand inventory control and recent trends

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

					AE-326: Supply Cha	in Mana	gement			
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** The main objective of supply chain management are to improve the overall organization performance and customer satisfaction by improving products or service delivery to customer. Supply chain management consists of all parties such as supplier, manufacturer, distributor retailers, customers directly or indirectly involved in fulfilment of customers' demands.

	AE-326: Supply Chain Management	Contact Hours
Unit-1	Introduction: Perspective of Supply Chain Management, Managing uncertainty, Key issue in supply chain management	8
Unit-2	Inventory Management and Risk Pooling: Inventory management, Classification of inventory, centralized versus Decentralized Warehousing and Risk pooling, Value of Information, Quantification of Bullwhip effect, Causes and remedies of Bullwhip effect	6
Unit-3	Resource planning: Aggregate Production Planning – Chase and leveling strategies, MRPI, MRP- II, Agile manufacturing Systems	6
Unit-4	Procurement and Outsourcing strategies: Introduction, outsourcing benefits and risks, Make/Buy decision, e-procurement, Vendor selection and quota allocation	8
Unit-5	Strategic Alliances: Introduction, Third party logistics, Demand driven strategies, Distribution strategies direct shipment, cross docking, transhipment, Supplier relationships management, Customer relationship management	8
Unit-6	International Issues in Supply Chain Management Concepts in Globalization, Globalization forces, Risks and Advantages of International supply chains, Issues in International supply chain management, Regional differences in logistics	6
	Total	42

Refe	erence Books:
1	Designing and Managing the Supply Chain: concepts, strategic and case studies by David Simchi-Levi, Philip
	kaminsky, Edith Simchi-Levi, Ravi Shankar, Tata McGrawHill, ISBN: 978-0070666986
2	Supply Chain Management by Chopra and Mendle, PHI, ISBN:-13:978-0132743952
3	Supply Chain Management: Text and Cases by JannatSah, Pearson Education, ISBN-13:978-8131715178

CO1	To study Supply Chain Management and its Key issues.
CO2	To study Inventory Management and Risk Pooling
CO3	To study MRPI, MRP-II, Agile manufacturing Systems
CO4	To study Procurement and Outsourcing strategies
CO5	To study Strategic Alliances, Distribution strategies direct shipment, cross docking, transhipment, Supplier relationships management
CO6	To study International Issues in Supply Chain Management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-328: Computer Integrated Manufacturing Systems										
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE	
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-	

**Objectives:** To familiarize the students with CIMS, Part Programming, Tooling and Fixture, Work piece Handling etc.

	AE-328: Computer Integrated Manufacturing Systems	Contact Hours
Unit-1	Introduction: Fundamental Concepts in Manufacturing and Automation- Need for Automation - Automation Strategies Economic Analysis and Production - Fundamental of CIMS	8
Unit-2	Computer Aided Design (CAD) : Elements of CAD System- Graphics Hardware - ALU- CPU - Input/Output Devices -Geometric Modeling - Automated Drafting	6
Unit-3	Manufacturing Systems : Basics of Numerical Control – Types of NC Systems - CNC and DNC Machines - Matching Centre– Tool Magazine - NC Tape Format - Programming – Manual Part Programme - Simple Programmes - Computer Assisted Part Programming - APT Language - Simple Examples	6
Unit-4	Flexible Manufacturing Systems: Group Technology - Part Families - Part Classification and Cooling – Production Flow Analysis - Machine Cell Design - Description of FMS -Equipment, Tooling and Fixture	8
Unit-5	Computer Aided Manufacturing: Computers in Manufacturing- Automated Manufacturing Systems -Workpiece Handling - Types of Transfer - Continuous, Intermittent and Non- Synchronous Walking Beam -	8
Unit-6	Computer Aided Process Planning – Computer Aided Inspection - Computer Aided Quality Control - Basic Model 100 off CIMS- Interfacing Methods of CAD And CAM – Computer Process Monitoring	6
	Total	42

Refe	erence Books:
1	Automation, Production Systems, and Computer-Integrated Manufacturing/Mikell P. Groover/Pearson Education, 2015/0133499715, 9780133499711
2	CAD/CAM: Computer-Aided Design and Manufacturing/Groover/Pearson Education India, 1984/8177584162, 9788177584165
3	Niebel, "Modem Manufacturing Process ", Mcgraw-Hill, 1989
4	Numerical Control of Machine Tools/Stanley John Martin/English Universities Press, 1970/0340114576, 9780340114575
5	Computer Integrated Manufacturing: From Fundamentals to Implementation/Alan Weatherall/Butterworth- Heinemann, 2013 / 1483163415, 9781483163413

CO1	To study fundamental Concepts in Manufacturing and Automation
CO2	To study Computer Aided Design and its elements.
CO3	To study NC, CNC, DNC.
CO4	To study Flexible Manufacturing Systems
CO5	To study Computer Aided Manufacturing
CO6	To study Computer Aided Process Planning

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE405: Design of Automobile Components											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** To familiarize the students with the process of design and analysis of engineering systems and to enhance critical thinking and prepare him for facing design challenges. To familiarize him with statistical, decision making and optimization tools

	AE405: Design of Automobile Components	Contact Hours
Unit-1	<b>Design of friction clutches:</b> common friction materials, single plate, multi plate and centrifugal clutches and their characteristics and design of friction clutches	8
Unit-2	<b>Mechanical gears:</b> Design of Helical, Bevel and Worm Gears, Belt and Chain drives and Automotive Gear box assembly. Brakes: Common friction materials, shoe, band, cone and disc brakes their characteristics and design of brake assembly	6
Unit-3	<b>Design of Bearings:</b> Rolling contact bearing: types of rolling contact bearings, static and dynamic load capacities, Stribeck's equation, equivalent bearing load, load life relationship, bearing life, load factor, selection of bearings from manufacturers catalogue. Lubrication and mountings, dismounting and preloading of bearings, oil seals and packing	6
Unit-4	<b>Sliding contact bearings:</b> bearing material and their properties, bearing types, and their constructional details, hydrodynamic lubrication- basic theory, design consideration in hydrodynamic bearings, Raimondi and Boyd method relating bearing variables	8
Unit-5	Design of Engine Parts: Piston, Engine Valves, Cylinder, Connecting Rod, Crank Shaft for CI and SI engines.	8
Unit-6	<b>Introduction to the design of automobile chassis</b> : Aerodynamic formulations, Calculation of various aerodynamic resistance	6
	Total	42

Refe	eference Books:											
1	Maleeve Hartman and O.P. Grover, "Machine Design", CBS Publication & Publishers, ISBN-13: 978-8123906379											
2	V.B Bhandari, "Machine Design", Tata Mcgraw Hill, ISBN 0070681791, 9780070681798											
3	P.C. Sharma and D.K Aggarwal., "Machine Design", S.K. Kataria& Sons, ISBN 8185749094, 9788185749099											

CO1	To study design of friction clutches and their characteristics.
CO2	To study mechanical gear, brakes and their characteristics.
CO3	To study design of bearing and its static and dynamic load capacities.
CO4	To study bearing and hydrodynamic lubrication
CO5	To study of design of engine components of SI and CI engine.
CO6	To study of design of Automobile chassis.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE407: Production And Operations Management									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	_

**Objectives:** This course aims to introduce the students to operationsstrategy, product and process design; demand forecasting and inventory control methods

	AE407: Production And Operations Management	Contact Hours
Unit-1	Operations strategy and competitiveness: Introduction to POM, Operations strategy, strategy design process, corporate and operations strategies, Operations competitive dimensions.	8
Unit-2	Product and Process Design : Product design and development processes, product life cycle, Process flow chart, Types of processes, Process performance, Learning curve.	6
Unit-3	Facility location and Layout: Factors affecting the location decisions, methods of facility location- factor rating systems, centroid method, and profit volume analysis; Types of layout, Block diagram and Assembly Line Balancing.	6
Unit-4	Demand Forecasting: Qualitative and quantitative forecasting, Time series and regression models, Measures of forecasting errors.	8
Unit-5	Inventory model: Importance of inventory, understocking and overstocking, Fixed order quantity models and fixed time period models (EOQ models), Selective inventory management- ABC, VED, and FSN analysis.	8
Unit-6	Lean Manufacturing : JIT manufacturing system, Toyota production systems- KANBAN model, and elimination of waste	6
	Total	42

Refe	erence Books:
1	Jay Heizer, Barry Render, Operations Management,; Publisher-Pearson learning (ISBN 9780132658812)
2	Chase, Jacob, and Aquilano ,Operations management for competitive advantage;; Publisher-TMH(ISBN 9780072983937)
3	Buffa and Serin, Modern Production/Operations Management, Publisher- John Weily India (ISBN 8126513721)

CO1	To study Operations strategy and competitiveness
CO2	To study Product design and development processes, product life cycle, Process flow chart, Types of processes, Process performance.
CO3	To study Facility location and Layout and Assembly Line Balancing.
CO4	To study Qualitative and quantitative forecasting, models and Measures of forecasting errors
CO5	To study Importance of inventory, models and Selective inventory management.
CO6	To study Lean Manufacturing JIT, TPS, KANBAN model, and elimination of waste.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE409: Computer Aided Vehicle Design and Safety									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	_

**Objectives:** To enable the students to understand the basics of Vehicle design process, design parameters and some relevant software. To understand the need for vehicle safety and the basic components of vehicle safety. To be familiarize with the existing and latest safety systems

	AE409: Computer Aided Vehicle Design and Safety	Contact Hours
Unit-1	Introduction: Study and Selection of a Vehicle; Specifications – Choice of Cycle, Fuel, Speed, Cylinder Arrangement, Number of Cylinders, Method of Cooling, Material, Design Variables and Operating Variables Affecting Performance and Emission of a vehicle. Performance Curves: vehicle Residence, Power and Torque Curve, Driving Force Against Vehicle Speed-Acceleration and Gradability in Different Gears for A Typical Car Or Truck Plotted From Specifications	8
Unit-2	Vehicle Body Details: Types: Saloon, Convertibles, Limousine, Estate Car, Racing and Sports Car. Visibility: Regulations, Driver's Visibility, Test for Visibility, Methods of Improving Visibility and Space in Cars. Safety Design, Safety Equipments for Cars. Car Body Construction; Design Criteria, Prototype Making,	6
Unit-3	Vehicle Aerodynamics: Objectives. Vehicle Drag and Types: Various Types of Forces and Moments, Effects of Forces and Moments, Side Wind Effects on Forces and Moments, Various Body Optimization Techniques for Minimum Drag, Wind Tunnel Testing: Flow Visualization Techniques, Scale Model Testing, Component Balance to Measure Forces and Moments. Gear Ratios Determination of Gear Ratios, Acceleration and Gradability	6
Unit-4	Engine Design: Pressure Volume Diagram, Frictional Mean Effective Pressure, Engine Capacity, Calculation of Bore and Stroke Length, Velocity and Acceleration, Gas Force, Inertia and Resultant Force At Various Crank Angles – Side Thrust on Cylinder Walls.	8
Unit-5	Indian and International Vehicle safety standards, requirement, various crash test methods, Initial Tests, Crash Tests on Full Scale Model, Dummies and Instrumentation, their computer aided simulations and applications.	8
Unit-6	Testing for Emissions: Various emission standards, standard test procedure, assessment of various emission control technologies, case studies	6
	Total	42

Ref	erence Books:
1	I C Engines by Lichty, Kogakusha Co., Ltd. Tokyo, 1991, ISBN-1-56091-563-3
2	Body Construction and Design by Giles. J.C., Liiffe Books Butterworth & Co, ISBN Number: 0-7680-0708-9
3	Vehicle Body Layout and Analysis by John Fenton- Mechanical Engg. Publication Ltd., London, ISBN, 0852984456
4	Vehicle Body Building and Drawing by Braithwaite.J.B.– Heinemann Educational Books Ltd., London, ISBN-13: 9781846289941

CO1	To understand Specifications of a Vehicle with its performance curves.
CO2	To understand Vehicle Body Details, Safety Design and Prototype Making.
CO3	To understand Vehicle Aerodynamics Wind Tunnel Testing
CO4	To understand Engine Design with its all parameters.
CO5	To understand Indian and International Vehicle safety standards with Crash Tests on Full Scale Model.
CO6	To understand Testing for Emissions with case studies.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-411: Vehicle Maintenance & Tribology									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To familiarize the students with the engine maintenance parameters, schedules, chasis maintenance of electrical systems, cooling systems, lubrication system.

	AE-411: Vehicle Maintenance & Tribology	Contact Hours
Unit-1	Introduction: nature of surfaces and contact, surface topography, friction and wear mechanisms and effect of lubricants, methods of fluid film formation. Lubrication Choice of lubricant type, oil, grease and solid lubricants, additives, lubrication systems and their selection, selection of pump, filters, piping design, oil changing and oil conservation. Failure of tribological components filure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using SOAP and Ferrography	6
Unit-2	Maintenance of records and schedules: 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	6
Unit-3	Engine maintenance – repair and overhauling 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. Performance evaluation for maintenance	8
Unit-4	Chassis maintenance - repair and overhauling: 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	8
Unit-5	Maintenance of automotive electrical system servicing and repairs: Testing methods for checking electrical components, checking battery, starter motor, Charging systems, dc generator and alternator, ignitions system, lighting systems. Fault Diagnosis and 92 maintenance of modern electronic controls, checking and servicing of Dash board instruments	8
Unit-6	Maintenance of fuel system, cooling systems, lubrication system and vehicle Body: 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	6
	Total	42

Ref	Reference Books:								
1	John Duke ,"Fleet Management",-Publisher- McGraw-Hill Co, USA (ISBN -13: 978- 0070174108), 1984								
2	Kitchin.L.D ,"Bus Operation"., Publisher - Illiffee and Sons Co., London, III edition (ISBN: B0007JG0US), 1992								
3	Government Motor Vehicle Act – Publication on latest act to be used as on date								

CO1	To understand basics of friction, wear and lubrication mechanism.
CO2	To understand Maintenance of records and schedules
CO3	To understand Engine maintenance and Performance evaluation for maintenance
CO4	To understand Chassis maintenance with Wheel alignment, computerized alignment and Wheel balancing
CO5	To understand Maintenance of automotive electrical system servicing and repairs
CO6	To understand Maintenance of fuel system, cooling systems, lubrication system and vehicle Body

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-413: Vehicle Transport Management									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To familiarize the students with concept of vehicle transport management. To familiarize him with understanding about vehicle transport management.

	AE-413: Vehicle Transport Management	Contact Hours
Unit-1	<b>INTRODUCTION :</b> Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems	8
Unit-2	. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests	6
Unit-3	<b>TRANSPORT SYSTEMS:</b> Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings	6
Unit-4	<b>SCHEDULING AND FARE STRUCTURE:</b> Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling	8
Unit-5	<b>MOTOR VEHICLE ACT:</b> 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	8
Unit-6	<b>MAINTENANCE:</b> 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	6
	Total	42

Ref	Reference Books:							
1	John Duke ,"Fleet Management",-Publisher- McGraw-Hill Co, USA (ISBN -13: 978- 0070174108), 1984							
2	Kitchin.L.D, "Bus Operation"., Publisher - Illiffee and Sons Co., London, III edition (ISBN: B0007JG0US), 1992							
3	Government Motor Vehicle Act –Publication on latest act to be used as on date							
CO1	To understand basics of personnel management, psychology, sociology.							
-----	---							
CO2	To understand methods of training, training procedure, psychological tests.							
CO3	To describe public transport traffic, secretarial and engineering divisions. chain of responsibility.							
CO4	To explain operating costs for transport vehicles with examples.							
CO5	To implement motor vehicle act.							
CO6	To apply Preventive maintenance system in transport.							

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-415: Power Plant Engineering											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** To familiarize the students with types of power plants, steam generators, combined cycle power plants, other power plants, control of power plants and environmental impact of power plants

	AE-415: Power Plant Engineering	Contact Hours
Unit-1	Classification of power plants: base load and Peak load power stations, co-generated power plant, captive power plant, and their fields of application & selection criteria, Indian energy scenario, Indian coals: formation, properties, analysis, benefication and heating value calculation of coals; cocking and non-cocking coals, fuel handling systems; coal gasification	8
Unit-2	Steam Generators: High pressure utility boiler, natural and forced circulation, fuel handling, coking and non-coking coal, coal benefication, coal pulverization, pulverized fuel firing system, combustion process, need of excess air, cyclone furnace, fluidized bed boiler, placement of evaporator, economizers, super heaters, re-heaters, air pre-heater in the boiler, de-aeration, boiler blow- down, ash collection by bag house, gravity separation, electrostatic precipitators and wet scrubbers, boiler efficiency calculations, water treatment: external and internal treatment	6
Unit-3	Combined Cycle Power Plants: Binary vapour cycles, coupled cycles, gas turbine- steam turbine power plant, gas pipe line control, MHD- Steam power plant, thermionic steam power plant, integrated coal combined cycle (IGCC) power plant	6
Unit-4	Other power plants : Nuclear power plants - working and types of nuclear reactors, boiling water reactor, pressurized water reactor, fast breeder reactor, controls in nuclear power plants, hydro power plant -classification and working of hydroelectric power plants, diesel and tidal power plants	8
Unit-5	Instrumentation and Controls in power plants: Important instruments used for temperature, flow, pressure, water/ steam conductivity measurement; flue gas analysis, drum level control, combustion control, super heater and re-heater temperature control, furnace safeguard and supervisory system (FSSS), auto turbine run-up system(ATRS), interlocks and protection of boiler turbines	8
Unit-6	Environment Pollution and Energy conservation: Economics of power generation: load duration curves, power plant economics, pollution from power plants, disposal/ management of nuclear power plant waste. concept of energy conservation and energy auditing	6
	Total	42

Refe	erence Books:
1	M.M. El Wakil, "Power Plant Engineering", Publisher-Tata McGraw Hill (ISBN 13: 9780072871029)
2	P.K Nag, "Power Plant Engineering", Publisher-Tata McGraw Hill( ISBN-13: 9789339204044)
3	by J Wiesman and R Eckart, "Modern Power Plant Engineering", Publisher-Prentice hall India Ltd (ISBN 9780135972526)
4	T.D Eastop and Mc Conkey", Applied Thermodynamics", Longman Scientific and Technical Publisher-Pearson (ISBN 8177582380)

CO1	To understand basics of power plant their types and Indian energy scenario, Indian coals.
CO2	To understand Steam Generators, boiler efficiency calculations and water treatment
CO3	To discuss Combined Cycle Power Plants
CO4	To explain Instrumentation and Controls in power plants
CO5	To explain nuclear power plants, hydro power plant and diesel and tidal power plants.
CO6	To apply environment pollution and Energy conservation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-417: Robotics & Automation												
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE			
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-			

**Objectives:** To introduce the student with types of robotics, fundamentals of robotics, languages used to program robots, sensing system for a robot and safety of robots

	AE-417: Robotics & Automation	Contact Hours
Unit-1	Introduction to Robotics, Classification of Robots, Characteristics of Robots, performance, advantages and disadvantages of a Robot, industrial applications of a Robo	8
Unit-2	Fundamentals of a Robot: Various system, structure and definition, terms relating to industrial Robots, basic terms related to Robot performance and Characteristics, Control volume of a Robot	6
Unit-3	Robot languages and programing	6
Unit-4	Controlling the Robot systems: Introduction to drives, Mechanical, Hydraulic, Pneumatic, electric drives, feed back control	8
Unit-5	Sensing system for a robot: Introduction, types of sensors, machine vision, Artificial intelligence, Control techniques	8
Unit-6	Robot safety: Introduction, potential safety hazards, safety planning check lists, safety guidelines, latest development in safety measurement	6
	Total	42

Refe	Reference Books:									
1	John j Craig, "Introduction to Robotics: Mechanics and Control", Publisher-Pearson education (ISBN									
	9780201543612)									
2	Y.Koren "Robotics for Engineers", Publisher-McGraw Hill Publications(ISBN 9780070353992)									

CO1	To study basics of robotics with industrial applications.
CO2	To discuss robot performance and Characteristics.
CO3	To describe robot languages and programing
CO4	To explain robot systems and its control.
CO5	To implement Sensing system for a robot with Artificial intelligence, Control techniques
CO6	To apply robot safety and latest development in safety measurement.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-419: Nuclear Energy									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To familiarize the students with the nuclear physics, nuclear energy, principles of nuclear reactors, types of reactors, heat transfer involved in reactors and waste management of radiative material

	AE-419: Nuclear Energy	Contact Hours
Unit-1	Nuclear Physics: Atomic number and mass numbers, Isotopes, Nuclear energy and nuclear forces, Binding Energy, Nuclear Stability, Radioactivity, Nuclear reactions, Radioactive isotopes, Law of radioactivity, Interaction of radiation (alpha,beta, gamma) with matter, Interaction of neutrons with matter, Absorption radiative capture, Transmutation Fission, Cross section for nuclear reactions. Fission process, Mechanism of nuclear fission, fission cross section, fission products, Basic radio chemistry	8
Unit-2	Reactor Physics: Neutron balance, Neutron diffusion, Diffusion equation, and its solution, Showing down of neutrons, Showing down power and moderating ratio. Reactor theory: Multiplication factors, Four factor formula, One group critical equation, Age, Diffusion method, 98 Nonleakage probabilities and effective multiplication factor, Multi group diffusion theory, Homogeneous and heterogeneous reactor systems, Time dependent reactor behaviour	6
Unit-3	Nuclear Reactor Engineering: Types of rectors, Ordinary water moderated reactors (BWR, PWRO), Heavy water cooled and moderated reactors, Gas cooled reactors (HTGR, AGR), Fast reactors design, Construction and control of nuclear reactors	6
Unit-4	Heat transfer in nuclear reactors: Heat transfer techniques in nuclear reactors, Design and operation, Thermal stresses, Reactor shielding	8
Unit-5	Reactor materials: Nuclear fuels, Moderators, Coolants, Reflectors and structural materials. Reprocessing: Nuclear fuel cycle, Spent fuel characteristics, Reprocessing techniques role of solvent extraction in reprocessing	8
Unit-6	Waste management and radiation protection: Types of waste, Waste management philosophy and disposal, ICRP recommendations, Radiation hazards and their prevention, Radiation dose units. Status of nuclear technology in India: Indian nuclear power program, Nuclear reactors in India, India's commitment to nuclear	6
	Total	42

# **Reference Books:**

1	S. Glasstone and A. Seronske, Van Nostrand – Reinhold, "Nuclear Reactor Engineering", Publisher- Technical
	Information Center, United States Atomic Energy Commission(ISBN 9780870790096), 1967
2	M. Bendict and T.A. Pigtor ,"Nuclear Chemical Engineering", Publisher- McGraw Hill, 1981(ISBN: 0070045313)
3	L. C. MerriteBasic Principles of Nuclear Science and Reactors, Publisher-Wiley Hill, 1981
4	S. E. Liverhandt, Introduction to Nuclear Reactor Physics (ISBN -13: 9781124145884)

CO1	To understand basics of nuclear physics.
CO2	To discuss reactor physics
CO3	To describe various types of rectors and construction and control of nuclear reactors
CO4	To explain heat transfer techniques in nuclear reactors, design and operation, and reactor shielding
CO5	To implement reactor materials and reprocessing techniques role of solvent extraction in reprocessing
CO6	To apply knowledge of waste management and radiation protection nuclear reactors in India.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE 421: Product design and development									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	_

**Objectives:** To familiarize the students with the process of product design and development and to enhance critical thinking and prepare him in the field of product design and development. To familiarize him with concept of product design and development

	AE 421: Product design and development	Contact Hours
Unit-1	Introduction: Classification/ Specifications of Products. Product life cycle. Product mix. Introduction to product design. Modern product development process. Innovative thinking. Morphology of design	8
Unit-2	Conceptual Design: Generation, selection & embodiment of concept. Product architecture. Industrial design: process, need. Robust Design: Taguchi Designs & DOE. Design Optimization	6
Unit-3	Design for Manufacturing.& Assembly: Methods of designing for Mfg.& Assy. Designs for Maintainability. Designs for Environment. Product costing. Legal factors and social issues. Engg ethics and issues of society related to design of products	6
Unit-4	Value Engineering / Value Analysis.: Definition. Methodology. Case studies. Economic analysis: Qualitative & Quantitative	8
Unit-5	Ergonomics / Aesthetics: Gross human autonomy. Anthropometry. Man-Machine interaction. Concepts of size and texture, colour. Comfort criteria. Psychological & Physiological considerations. Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design	8
Unit-6	Concurrent Engineering, Rapid prototyping, Tools for product design – Drafting / Modeling software. CAM Interface. Patents & IP Acts. Overview, Disclosure preparation	6
	Total	42

Ref	erence Books:
1	David G Ullman, "The Mechanical Design Process." Publisher- McGrawhillIncSingapore (ISBN-13:
	9780072975741) 1992 N J M Roozenberg, J Ekels, N F M Roozenberg "Product Design Fundamentals and
	Methods ."Publisher- John Willey & Sons (ISBN-13: 9780471954651) 1995
2	Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development."
	1 / e 2004, Publisher- Pearson Education New Delhi (ISBN-13: 9780130212719)
3	L D Miles "Value Engineering."Publisher- McGraw-Hill, 1972
4	Karl T Ulrich, Steven D Eppinger, "Product Design & Development." Publisher- Tata McGrawhill New Delhi
	(ISBN-13: 9780078029066)2003
5	Hollins B & Pugh S "Successful Product Design." Publisher- Butter worths London (ISBN 9780408038614)

CO1	To understand basics of product design. modern product development process.
CO2	To discuss conceptual design, industrial design and robust design.
CO3	To explain Design for Manufacturing & Assembly with ethics and issues of society related to design of products.
CO4	To describe value engineering and value analysis with case studies.
CO5	To describe ergonomics with Psychological & Physiological considerations. Creativity Techniques
CO6	To apply knowledge of concurrent engineering, rapid prototyping and patents & IP act.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE 423: Financial Management									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To introduce students with fundamentals of managing finances, various techniques used, planning of finance, cost accounting and financial analysis.

	AE 423: Financial Management	Contact Hours
Unit-1	Fundamentals of Financial Management: Introduction, Objectives, goals and functions of financial Management. Time value of Money, Risks and Returns, Valuation of Securities	8
Unit-2	Financial Instruments And Markets: Forms of Business Organizations, capital structure, Construction analysis and interpretation of standard financial statements, Dividend policy and share valuation	6
Unit-3	Capital Budgeting: Concept of Operating cycles and working of Capital Management; Capital Budgeting: Cost of capital investment decisions and Risk analysis in Capital Budgeting	6
Unit-4	Financial Planning: Planning of profit and leverages (operating and financial) Risk and Return: Nature of risk, Inter-relationship in risk and return, effect of Tax on return	8
Unit-5	Cost Accounting: Definition and scope of cost accountancy and costing methods, elements of cost overhead classification distribution and absorption, process costing-Uniform, Marginal and standard costing methods, Case studies	8
Unit-6	Inflation and Financial Management: Inflation and Asset revaluation, firm value, financial market returns, financial analysis, capital budgeting	6
	Total	42

Ref	Reference Books:							
1	Khan and Jain , "Financial Management", Publisher-TMH (ISBN: 978-0-07-065514- 7)							
2	I. M. Pandey, "Financial management" Publisher- Vikas Publishing House PVT. ltd (ISBN: 812591658X)							

CO1	To study fundamentals of financial management
CO2	To study Financial Instruments And Markets
CO3	To study capital budgeting, capital cost and risk analysis
CO4	To study financial planning, risk and return and their interrelation.
CO5	To study cost accounting andits elements with case studies.
CO6	To study inflation and financial management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE 425: Fracture mechanics									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objective:** To familiarize the students with basics of Griffith's energy balance approach, the shape of the plastic zone for plane stress and plane strain cases, Stress intensity factors and plane strain fracture toughness. To impart in-depth knowledge of elastic plastic fracture mechanics and fatigue crack propagation and applications of fracture mechanics.

	AE 425: Fracture mechanics	Contact Hours
Unit-1	<b>Introduction</b> : Introduction and overview Inter-disciplinary approaches in fracture mechanics, modes of deformation and failure, Griffith theory.	6
Unit-2	<b>Linear Elastic Fracture Mechanics</b> : Stress concentration in the vicinity of notches and cracks, concept of stress intensity factor (SIF), Stress intensity factor for different types of cracks and geometry. Irwin's stress intensity approach, fracture toughness.	6
Unit-3	<b>General Yielding Fracture Mechanics:</b> Crack tip plastic zones and its evaluation, Wall's crack opening displacement. Barenblatt and Dugdale's models.	8
Unit-4	<b>Evaluation of Fracture Mechanics Parameters:</b> Plane strain fracture toughness testing i.e., Kic Concepts of crack tip opening displacements (CTOD)	8
Unit-5	<b>J-Integral and fatigue crack:</b> J integral and its evaluation, application of J-integral. Mechanics of fatigue crack propagation.	6
Unit-6	<b>Fatigue crack propagation and applications of fracture mechanics</b> : Crack nucleation and growth and the stress intensity factor. Factors affecting crack propagation, fatigue life prediction, Paris law, statistical analysis, variable amplitude service loading, means to provide fail-safety, required information for fracture mechanics approach, mixed mode (combined) loading and design criteria. Fracture of composite materials.	8
	Total	42

Refe	erence Books:
1	Prashant Kumar; 'Elements of Fracture Mechanics"; Publisher- Tata McGraw- Hill Publishing Company
	Limited(ISBN 0070656967)
2	Knott.J.F; "Fundamentals of Fracture Mechanics", Publisher-John Wiley & Sons, Newyork(ISBN 0408705299)
3	Gdoutos.E.E; "Fracture Mechanics- An introduction"; Publisher-Springer (ISBN 9401581584)
4	Ramesh.K; "e-Book on Engineering Fracture Mechanics"; IIT Madras (ISBN: 978-81-904235-0-2)
5	T. L. Anderson, "Fracture Mechanics: Fundamentals and Applications", PublisherCRC Press(ISBN 0849342600)
6.	P. Kumar, "Elements of Fracture Mechanics", Publisher- Wheeler Publishing

CO1	To understand the sources of crack, interpret and use the concepts of fracture mechanics with stress concentration.
CO2	To discuss the concepts of shape of the plastic zone for plane stress and plane strain cases in
	formulating and solving design problems.
CO3	To explain the assumptions underlying several numerical and experimental methods of determination of
	fracture toughness and be able to the concepts of crack resistance, J-integral tearing modulus and stability.
CO4	To analyze the Crack-tip opening displacement its application and experimental determination with
	understanding of Parameters affecting the critical CTOD and use of J integral.
CO5	To interpret, analyses the concepts of fracture mechanics in fatigue crack propagation.
CO6	To apply of the concept of fracture mechanics for practical application.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-404: Total Life Cycle Management									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To familiarize the students with the concept of Total Life Cycle, management of old vehicles, applying life cycle thinking to define tradeoffs. This course also introduces to sustainability, use of renewable resources

	AE-404: Total Life Cycle Management	Contact Hours
Unit-1	Introduction: Definition of Total Life Cycle (TLC) – Concept of TLC - Life Cycle Impacts – Integrating Life Cycle Technologies- Products and Processes Within TLC - TLC Methodology- TLC Assessment Data to Complex Products – Resultant Improvement for Product	8
Unit-2	Vehicles End of Life: Design for End of Old Vehicle Management - Problems of Old Vehicles in Emerging Markets.	6
Unit-3	Recovery and Economic Feasibility of Materials Such as Plastic, Rubber, Aluminium, Steel, Etc	6
Unit-4	Tradeoffs: Applying Life Cycle Thinking to Define Tradeoffs along the Supply, Manufacture - Use and End of Life Chain- Effects on the Customer - Expectation of the Customer -Evaluate Product Cost on Fuel Consumption, Emission, Durability, Environment and Health	8
Unit-5	Sustainability: What Is Sustainability - Use of Renewable Resources - View to Design Horizon.	8
Unit-6	Harmonization of Environmental Goals: Tlc for Emerging Vs Developed Markets - Rules and Regulations to Guide Designers - International Common Practices for End of LifeVehicles	6
	Total	42

Ref	Reference Books:						
1	Life Cycle Management Case Study of an Instrument Panel /SAE, 1997/						
2	Accident Reconstruction: Automobiles, Tractor-semitrailers, Motorcycles, and Pedestrians /Society of Automotive						
	Engineers, 1987 /0898834546, 9780898834543						

CO1	To study basics of total life cycle management.
CO2	To analyses design for end of old vehicle management with its problems in emerging markets.
CO3	To discuss recovery and economic feasibility of materials.
CO4	To explain life cycle thinking to define tradeoffs along the supply, manufacture - use and end of life chain
CO5	To describe sustainability through use of renewable resources
CO6	To knowledge of environmental international common practices for end of life vehicles

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-406: Refrigeration & Automobile Air Conditioning											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** To familiarize the students with the basic concepts of Refrigeration and Air conditioning principles of designing and maintenance of air-conditioning system.

	AE-406: Refrigeration & Automobile Air Conditioning	Contact Hours
Unit-1	Refrigeration: ton of Refrigeration, Various Methods of Producing Refrigeration, Applications, Heat Pump, Reversed Carnot Cycle and Its Limitations,	6
Unit-2	Vapour Compression Cycle, Subcooling, Superheating, Liquid Vapour Heat Exchanger, Effect of Changes in Evaporator Condenser Temperatures, Deviations From Ideal Cycle. Refrigerants and Their Properties, Alternative Refrigerants	6
Unit-3	AIRCONDITIONING FUNDAMENTALS Basic air conditioning system - location of air conditioning components in a car, schematic layout of a refrigeration system, compressor components, condenser and high pressure service ports, thermostatic expansion valve, expansion valve calibration, controlling evaporator temperature, evaporator pressure regulator, evaporator temperature regulator	7
Unit-4	AIR CONDITIONER – HEATING SYSTEM Automotive heaters, manually controlled air conditioner, heater system, automatically controlled air conditioner and heater systems, automatic temperature control, air conditioning protection, engine protection	7
Unit-5	AIR ROUTING AND TEMPERATURE CONTROL Objectives, evaporator airflow through the recirculation unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control and handling systems	8
Unit-6	AIR CONDITIONING SERVICE Air conditioner maintenance and service, servicing heater system removing and replacing components, trouble shooting of air controlling system, compressor service	8
	Total	42

Refe	erence Books:
1	William H. Crouse and Donald I. Anglin - "Automotive Air conditioning" - McGraw Hill Inc 1990, ISBN:
	9780070148574
2	Boyce H.D Wiggins -"Automotive Air Conditioning" - Delmar - 2002, ISBN:10:0827319428/ISBN:
	13:9780827319424
3	Mitchell information Services, Inc - "Mitchell Automatic Heating and Air Conditioning Systems" - Prentice Hall
	Ind. – 1989, ISBN: 13:978-0135862230, 10:013586223X
4	Paul Weiser - "Automotive Air Conditioning" - Reston Publishing Co., Inc., - 1990, ISBN: 978-0835902618
5	MacDonald, K.I., - "Automotive Air Conditioning" - Theodore Audel series - 1978, ISBN: 0672233185
	9870672233180
6.	Goings.L.F "Automotive Air Conditioning" - American Technical services -1974, ISBN: 978-0826902108

CO1	To study basics of refrigeration and Applications.
CO2	To discuss heat exchanger, different refrigerants and their properties.
CO3	To explain basic air conditioning system and its components.
CO4	To describe air conditioner – heating system
CO5	To implement air routing and temperature control and its different units.
CO6	To apply air conditioner maintenance and service for practical problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-408: Fuel Cells										
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE	
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-	

**Objectives:** To familiarize the students with the concepts and analysis of fuel cells. To familiarize the student about conventional and latest trends in this area.

	AE-408: Fuel Cells	Contact Hours
Unit-1	Introduction and Thermodynamics : Introduction: Basic Operating Principles – Historical Highlights – Classification. Thermodynamics: Electrochemical Energy Conversion – Theoretical Efficiency – Electrochemical Energy Conversion – Factors Affecting Electrochemical Energy Conversion	8
Unit-2	Electrode Kinetics : Electrode Double Layer – Electrolyte Double Layer – Double Layer Models (Helmoltz Model, Gouy-Chapman Model, Stern Model, Grahame Model – Bockris, Devenathan and Muller Model, and Chemical Models)– Solid Metallic Electrode – Semiconductor Electrode – Specific Adsorption – Zero Potential	6
Unit-3	Alkaline Fuel Cells & Phosphoric Acid Fuel Cells: Alkaline Fuel Cells: Working Principle – Components – Modules and Stacks – Performance Characteristics (Power Density, Space Applications, Atmospheric Pressure Cells) – Limitations and R&D Challenges – System Issues – Ammonia As Fuel. Phosphoric Acid Fuel Cells: Cell Reactions – Electrodes (Stability of Catalysts, Electrode Fabrication – Fuel Cell Performance) – Stacks and Systems	6
Unit-4	Solid Oxide Fuel Cells & Molten Carbonate Fuel Cells: Solid Oxide Fuel Cell: Principle of Operation – Benefit sand Limitations – Cell Components (Electrolytes, Zirconia Systems, Ceria Based Electrolytes, Perovskite-Based Systems)– Cathode Materials – Anode Materials Interconnects –Fuel Reactions –Configurations and Performance (Tubular, Monolithic, Planar) – Environmental Impact –Applications. Molten Carbonate Fuel Cell: General Principle – Components(Electrolyte and Matrix, Cathode and Anode Materials) –Electrode Reactions – Life Time	8
Unit-5	Direct Methanol Fuel Cells & Proton Exchange Direct Methanol Fuel Cells: Operating Principle– Noble Metal Issue – Electro-Oxidation of Methanol (Catalysts, Oxygen Electro-Reduction, Electrolyte, Non-Catalytic Aspects) - Methanol Crossover – Catalyst Optimization – Vapour Feed Versus Liquid Feed Cells. Proton Exchange	7
Unit-6	Membrane Fuel Cells: Operating Principle(Membranes, Electrodes and Electrolysis, Optimization of Membrane and Electrode Assembly Impurities) – Technology Development (Single Cell and Stacks, Composite Plates) – Fuel Processing – Modeling Studies (Membrane, Electrode, Membrane-Electrode Assembly, Fuel Cell, Stack and System) – Technology Development and Applications	7
	Total	42

Ref	erence Books:
1	Viswanathan, B. and AuliceScibioh, M., Fuel Cells Principles and Applications, Universities Press (India) Pvt. Ltd.,
	Hyderabad, 2006, ISBN:97814200602871420060287
2	Hoogers, G., Edr., Fuel Cell Technology Handbook, Crc Press, Washington D. C., 2003, ISBN:9780849308772

CO1	To study historical background and basics of fuel cells.
CO2	To explain electrode kinetics and models
CO3	To discuss alkaline fuel cells & phosphoric acid fuel.
CO4	To describe direct methanol fuel cells & proton exchange direct methanol fuel cells.
CO5	To implement Solid Oxide Fuel Cells & Molten Carbonate Fuel Cells
CO6	To apply membrane fuel cells: operating principle technology development and applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-410: Modern Vehicle Technology											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** To familiarize the students with modern vehicles, trends in power plants, new techniques of reduction of noise and pollution; vehicle automated tracks.

	AE-410: Modern Vehicle Technology	Contact Hours
Unit-1	Trends in Power Plants : Hybrid Vehicles - Stratified Charged/ Learn Burn Engines - Hydrogen Engines - Battery Vehicles– Electric Propulsion With Cables - Magnetic Track Vehicles	8
Unit-2	Suspension Brakes and Safety: Air Suspension – Closed Loop Suspension - Antiskid Braking System, Retarders, Regenerative Braking Safety Cage - Air Bags - Crash Resistance- Passenger Comfort	6
Unit-3	Noise and Pollution: Reduction of Noise - Internal & External Pollution Control Through Alternate Fuels/Power Plants – Catalytic Converters and Filters for Particulate Emission	6
Unit-4	Vehicle Operation and Control: Computer Control for Pollution and Noise Control and for Fuel Economy -Transducers and Actuators - Information Technology for Receiving Proper Information and Operation of the Vehicle Like Optimum Speed and Direction	8
Unit-5	Vehicle Automated Tracks: Preparation and Maintenance of Proper Road Network - National Highway Network with Automated Roads and Vehicles	8
Unit-6	Satellite Control of Vehicle Operation for Safe and Fast Travel	6
	Total	42

Ref	erence Books:
1	Noise and Vibration control engineering : principles and applications / Istvan L.Ver, Leo Leroy Beranek John Wiley
	& Sons, 2006//0471449423, 9780471449423
2	Automotive Handbook/Robert Bosch, Robert Bosch GmbH./SAE, 1993/0837603307, 9780837603308

CO1	To understand Trends in Power Plants
CO2	To understand vehicle automated tracks and safety
CO3	To discuss suspension brakes and safety
CO4	To explain Noise and Pollution through different means.
CO5	To describe preparation and Maintenance of proper road network
CO6	To knowledge of satellite control of vehicle operation for safe and fast travel

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

					AE-412: Automobiles Vibr	ration Sy	stem A1	nalysis		
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course aims to introduce the student with fundamentals of vibrations, multi-degree of freedom systems, dynamic analysis and frequency analysis

	AE-412: Automobiles Vibration System Analysis	Contact Hours
Unit-1	Introduction: Simple Harmonic Motion, Terminology, Newton's Law, D'Alembert's Principle, Resonance, Introduction to Mechanism of Damping. Damped and Undamped Oscillations. Degrees of Freedom. Various Mechanisms of Damping. Equivalent Viscous Damping	8
Unit-2	Single Degree of Freedom Systems: Free Vibrations, Free Damped Vibrations, Forced Vibrations With and Without Damping. Support Excitation and Vibration Measuring Instruments. Amplitude and Phase Response Diagrams. Generalized Single Degree of Freedom Systems for Continuous Structures and Computation of K, M and C.	6
Unit-3	Multi Degree of Freedom Systems: Two / Three Degree of Freedom Systems, Static and Dynamic Coupling, Vibration Absorbers, Principal Coordinates, Principal Modes, Orthogonality Conditions Hamilton's Principle, Lagrange's Equation and Application. Longitudinal Vibration, Lateral Vibration, Torsional Vibration of Shafts, Dynamical Equations of Equilibrium of Elastic Bodies, Natural Frequencies and Mode shapes Determination	6
Unit-4	Frequency Analysis: Methods Determining Natural Frequencies and Mode Shape. Natural Vibrations of Solid Continua. Determination of Eigen Values and Eigen Modes. Introduction to Approximate Methods for Frequency Analysis Rayleigh Ritz Method for Vibration Analysis. Diagonalization of Stiffness, Mass and Damping Matrices Using Orthogonality Conditions	8
Unit-5	Dynamic Analysis: Matrices for Dynamic Analysis. Kinematically Consistent Load Systems and Determination of [K], [M], [C] and [L] Matrices. Normalization and Formulation of Modal Equations.	7
Unit-6	Steady State Analysis: Steady State Response, Using Fourier Analysis for Decomposing Complex Periodic Load Functions, of Modal Equations Using S-Plane Representation. Transient Response Analysis of Modal Equations Using Duhamel's Integrals	7
	Total	42

Refe	erence Books:
1	Theory of vibration with applications / William Tyrrell Thomson / Prentice-Hall, 1972 /0139145494, 9780139145490
2	Mechanical Vibrations/New Chand, 2009 / 8185240566, 9788185240565
3	Introductory Course on Theory & Practice of Mechanical Vibrations / J.S. Rao, Dr. K. Gupta / Wiley Eastern, 1984 / 0852267835, 9780852267837
4	Mechanical Vibrations / Rao / Pearson Education India, 2003 / 8177588745, 9788177588843

CO1	To understand basics of automobiles vibration system.
001	To understand busies of automobiles violation system.
000	To discuss single degrees of freedom systems
002	To discuss single degree of needon systems.
CO3	To explain multi degree of freedom systems
000	To explain multi degree of needom systems.
CO4	The sector methods determining returns from an end methods for first success and have
CO4	I o analyze methods determining natural frequencies and methods for frequency analysis
CO5	To implement dynamic analysis and normalization and formulation of modal equations
	To implement dynamic unarysis and normanization and formatiation of modal equations.
CO6	Te employee and the of Steeley State A polygic for acceptudies
000	Ito apply knowledge of Steady State Analysis for case studies.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

					AE-414: Renewable	Energy S	Sources			
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To familiarize the students with renewable energy sources like solar, geothermal, wind and tidal.

	AE-414: Renewable Energy Sources	Contact Hours
Unit-1	Man and Energy, world production and reserve of conventional energy sources, Indian production and reserves, Energy alternatives	7
Unit-2	Solar radiation: Origin, nature and availability of solar radiation, estimation of solar radiation. Photovoltaic cells. Design consideration and performance of different types of solar cells. Flat plate, focusing collectors. Effects of receiving surface location and orientation	7
Unit-3	Devices for solar thermal collection and storage. Energy storage devices such as water storage systems, packed Bed storage systems, phase change storage systems. Heat transfer considerations relevant to solar energy. Characteristics of materials and surfaces used in solar energy absorption	7
Unit-4	Application systems for space heating, solar water pumps, solar thermal pond, Solar Thermal Power plants, solar distillation, Solar Refrigeration and solar air conditioning, other solar energy utilization	7
Unit-5	Solar PV systems. Fuel Cell Technologies. Generation and utilization of biogas, design of biogas plants, Wind energy systems.	7
Unit-6	Geothermal Energy Systems. Tidal energy systems. Oceanic power generation. Design considerations, Installation and Performance Evaluation. MHD power generations. Role of the nonconventional energy sources in power planning.	7
	Total	42

Refe	Reference Books:							
1	G. D. Rai, "Energy Technolgy", Khanna Publishers, ISBN- 97881740907438							
2	S.P. Sukhatme", Solar Energy", Tata-Mcgraw hill, New Delhi, ISBN- 0074624531.							
3	"Solar Energy thermal process" JADuffie and W.A. Beckman, John Wiley& sons, New York, ISBN- 1118418123							
4	Solar energy, Frank Kaieth& Yogi Goswami, Taylor and Francis, ISBN- 1560327146.							
5	Treatise of Solar Energy, H.P. Garg, John Willey & sons, ISBN- 9027719306.							

CO1	To study basics of Renewable Energy Sources
CO2	To discuss solar radiation, design consideration and performance of different types of solar cells
CO3	To describe devices for solar thermal collection and storage
CO4	To explain different application systems of solar energy
CO5	To analyze Solar PV systems. Fuel Cell Technologies, design of biogas plants, Wind energy systems.
CO6	To apply knowledge of geothermal energy systems for practical problems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-416: Vehicle Safety Engineering											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** To familiarize the students with the safety systems for automobiles, testing for safety, environment related testing and Motor vehicle Acts

	AE-416: Vehicle Safety Engineering	Contact Hours
Unit-1	Automotive vehicle testing for Safety: Introduction to active& passive vehicle safety systems	8
Unit-2	Braking test (as per IS 11852-2001), ABS performance & Traction control test Seat belt anchorage testing, Horn, lighting installation and mirror, test and their simulation	6
Unit-3	Collapsible steering column testing: Frontal crash test, side door intrusion, interior and exterior test. Body block test (IS-11939-1996), Introduction to the offset, Frontal impact test (IS-11939-1996. &(ECE 94), Lateral Impact (ECE R95), AIS-029: SURVIVAL SPACE FOR OCCUPANTS, pedestrian protection test and other upcoming standards	6
Unit-4	Environment related testing: Emission test: As per TAP 115, Full throttle test for engine, pass by noise test and their simulation	8
Unit-5	Performance: gradability, Steering effort test, turning circle diameter test and their simulation Controls: speedometer calibration, MPFI, CRDI calibration test and their simulation	8
Unit-6	Motor Vehicle Act (1988), Central Motor Vehicles Rules (1989) and subsequent amendments	6
	Total	42

# **Reference Books:**

1	Integrated Automotive Safety Handbook by U.W. Seiffert& M. Gonter Published by SAE-International ISBN (978-07680-6437-7)

CO1	To study automotive vehicle testing for safety
CO2	To discuss different test of different parts of automotive vehicle.
CO3	To describe collapsible steering column testing
CO4	To analyze Environment related testing and their simulation
CO5	To explain performance of different parts test and their simulation
CO6	To apply motor vehicle act, vehicles rules and subsequent amendments for case studies.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-418: Packaging Technology											
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE		
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-		

**Objectives:** To familiarize the students with packaging as intregral process, packaging materials, testing standards and quality.

	AF-118. Packaging Technology	Contact
	AL-410. I ackaging recimology	Hours
Unit-1	Introduction: Packaging as an integral process in production and marketing, Packages, Packaging characteristics, Physical properties. Mechanism of spoilage, degradation, corrosion& Their prevention. Compatibility-permissible plasticizers and their migration to food products. Package design	8
Unit-2	Packaging Materials: Papers and specialty papers, cellulosic films and laminates. Plastic-PE, PP PS, PVC, PVDC, Nylon, Polyester and their combinations. Expanded PE,PS and bubble films. Glass containers, ampoules and vials. Composite containers, drums and paper tubes. Aluminium foils, laminates and coating. Single layer and multilayer polymer packaging	6
Unit-3	Ancillary materials: Adhesives, Adhesive tapes. Cushioning materials and properties, reinforcements. Stitching methods. Seals and enclosures. Lining compounds and lacquers. Labels and instant labeling. Ink jet printing and bar coding. Graphic design. Printing techniques Printing inks and print evaluations	6
Unit-4	Testing, Standards and Quality control: Mechanical testing, resistance to light, insect and mould. Barrier testing for air, oxygen etc., shelf life, worthiness of filled packages. Seal tests	8
Unit-5	Standards- basic concepts for rigid and non-rigid and ancillary materials standards for export packages, ISO 9000 and implications. Eco packaging and regulations	8
Unit-6	Process machinery and equipment: Machinery and equipment for manufacture of bottles, carry- bags and laminates	6
	Total	42

Refe	Reference Books:									
1	Daniel Lu,"Materials for Advanced Packaging", Publisher – Springer(ISBN-13: 9780387782188),2008									
2	Brody "Encyclopedia of PackgingTechnolgy", Publisher - John Wiley									
3	Piringer& Bauer "Plastics Packaging", publisher -, Wiley Interscience (ISBN-13: 9783527314553), 2008									
4	Selke "Plastics Packaging", Publisher – Hanser (ISBN-13: 9781569903728), 2004									
5	Morris ,"Nano Packaging" ,publisher - Springer(ISBN:9780387473253),2008									

CO1	To study basics of Packaging, Packaging characteristics, Physical properties and Package design.
CO2	To discuss different packaging materials.
CO3	To explain adhesives, stitching methods. seals and enclosures, labeling. ink jet printing and bar coding
CO4	To analyze testing, standards and quality control of packaging materials.
CO5	To describe different standards, rules and regulations for eco packaging.
CO6	To apply machinery and equipment for manufacture of bottles, carry-bags and laminates.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-420: Mechatronics									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To familiarize the students with basic electronics concept, types of sensors and transducers, microprocessors and microcontrollers and mechatronic product design.

	AE-420: Mechatronics	Contact Hours
Unit-1	Basic Electronics & Computation: Logic Gates, Passive Electrical 6 and Active Electronic Elements, Ic and Their Characteristics, Number System, Boolean Algebra, Digital Circuit Technologies: Rtl/Dtl/Dctl/ Ttl/ Mos/ Cmos/Ecl, Combinational and Sequential Circuits, Flip-Flops, Counters, Timers, Shift Registers. Memory System: Ram, Rom, Eprom, Eeprom, Pal, Plds, and gas	8
Unit-2	Sensors and Transducers: An Introduction to Sensors and Transducer, 6 Classification, Static and Dynamic Characteristics, Sensors for Motion and Position, Force, Torque and Tactile Sensors, Flow Sensors, Temperature Sensing Devices, Range Sensors, Ultrasonic Sensors, Fiber Optic Devices in Mechatronics. Actuators: -Hydraulic, Pneumatic and Electric Actuators.	6
Unit-3	Microprocessor and Microcontroller: 8085 Microprocessor 8 Architecture and Its Operations- Memory-Input, Output Devices, Microprocessor Systems, Application in Temperature Control& Traffic Control. Micro Controller Intel-8051, Basic Features, Application in Domestic Washing Machine	6
Unit-4	System Modeling: Mathematical Models, Building Blocks of 8 Mechanical, Electrical, Fluid and Thermal System. Systems, Rotational-Translation Systems, Electromechanical Systems, Hydraulic-Mechanical Systems	8
Unit-5	Signal Conditioning & Data Presentation System: D and A 8 Converters, Operational Amplifier; Protection, Filtering, Digital Signals, Multiplexers, Pulse Modulation, Data Acquisition, Digital Signal Processing; Pulse Modulation; Data Presentation Systems – Displays; Data Presentation Elements; Magnetic Recording; Data Acquisition Systems; Testing & Calibration, Interfacing Da and Ad Converters	8
Unit-6	Mechatronic Product Design: Traditional and Mechatronics Design 6 Approach, Autotropic: Wind Screen Wiper Motion, Engine Management System, Digital Speedometer and Odometer, Automatic Dim and Bright Control, Engine Temperature Measurements, Radiator Water Level Indicator, Bath Room Scale, A Pick & Place Robot, Automatic Camera, & Bar Code Recorder. Introduction to Mems, Nems. Mechatronics Application in Bionics and Avionics	6
	Total	42

Refe	erence Books:
1	AppuuKuttan, K. K. ,"Introduction to Mechtronics",publisher : Oxford University Press(ISBN
	NO.9780195687811),2007
2	W. Bolton ,"Mechatronics" PublisheR: Addition Wesley (ISBN NO:9788131762578)
3	DevdasShetty and Richard A. Kolk Thomson Brooks/Cole ,"Mechatronics System Design" Publisher: C L
	Engineering(ISBN-13: 9781439061985), 1997
4	David G. Alciation and Michae-L B. Hist, "Introduction to Mechatronics and Measuring System" Publisher: Tata
	Mcgraw Hill(ISBN NO: 9780071163774),1999
5	Mahalik, N.P. "Mechatronics Principles, Concepts and Application", Publisher: Tata McgrawHill(ISBN NO:0-70-
	048374-4),2006

CO1	To study basics of Electronics & Computation
CO2	To discuss different types of sensors and transducers.
CO3	To explain different types of microprocessors and microcontroller.and Applications.
CO4	To describe system modeling of different systems.
CO5	To implement Signal Conditioning & Data Presentation System
CO6	To apply mechatronic product design and applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-422: Tractors and Farm Equipment and Off-Road Vehicles									
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course introduces to general design of tractors, farm equipments; engine framework, off road vehicles and maintenance machines

	AE-422: Tractors and Farm Equipment and Off-Road Vehicles	Contact Hours
Unit-1	General Design of Tractors: Classification of Tractors-Main Components of Tractor-Safety Rules. Control of the Tractor and Fundamentals of Engine Operation: Tractor Controls and the Starting of the Tractor Engines-Basic Notions and Definition-Engine Cycles Operation of Multi cylinder Engines-General Engine Design - Basic Engine Performance Characteristics	8
Unit-2	Engine Frame Work and Valve Mechanism of Tractor: Cylinder and Pistons-Connecting Rods and Crank shafts Engine Balancing – Construction and Operation of the Valve Mechanism-Valve Mechanism Components – Valve Mechanism Troubles. Cooling System,	6
Unit-3	Lubrication System and Fuel System of A Tractor: Cooling System – Classification – Liquid Cooling System – Components, Lubricating System Servicing and Troubles – Air Cleaner and Turbo Charger – Fuel Tanks and Filters –Fuel Pumps	6
Unit-4	Farm Equipment's: Working Attachment of Tractors-Farm Equipment – Classification – Auxiliary Equipment – Trailers and Body Tipping Mechanism	8
Unit-5	Introduction of off-Road Vehicles: Classification of off-Road Vehicles and their Application Excavator: Different Types of Shovel and Dragline, Their Construction, Operating Principles, Operating Cycles. Production Capacity and cost of Production Transport Equipment: Various Types of Dumpers, Main System, Components and Carrying Capacity of Dumper	8
Unit-6	Road Making and Maintenance Machines: Different Types of Dozer, Grader, and Their Construction. Operating Principles, Production Capacity and Application Mechanism. Other Equipment: Scraper and Front-End Loader, Their Construction and Operation Maintenance: Maintenance Aspect of off Road Vehicles	6
	Total	42

Refe	erence Books:
1	Abrosimov, K. Bran Berg, A and Katayer, K. Road Making Machinery, M I R. Publishers Moscow. 1971
2	De, A. Latest Development of Heavy Earth Moving Machinery, Annapurna Publishers, Dhanbad 1995
3	Nichols, Herber L (Jr.), Moving the Earth, Galgotia Publishing House, New Delhi, 1962
4	Rudnev, V. K., Digging of Soils by Earthmover With Power Parts, Oxanian Press Pvt. Ltd., New Delhi
5	Rodichev and G.Rodicheva, Tractor and Automobiles, Mir Publishers, 1987
6.	Kolchin. A., and V.Demidov Design of Automotive Engines for Tractor, Mir Publishers, 1972

CO1	To study basic of Tractors, classification and its components.
CO2	To discuss engine components and its mechanism.
CO3	To explain lubrication system and fuel system of a tractor
CO4	To analyze Working Attachment of Tractors-Farm Equipment
CO5	To implement off-Road Vehicles and their Application Excavator
CO6	To apply Road Making and Maintenance Machines, Maintenance Aspect of off-Road Vehicles.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2

	AE-424: Automobile process control										
L	Т	Р	Credit	Area		CWS	PRS	MTE	ETE	PRE	
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-	

**Objectives:** To understand various methods to control automotive processes, resource planning, operational performance, control system.

	AE-424: Automobile process control	Contact Hours
Unit-1	Introduction: Classification/ Specifications of Products. Product life cycle. Product mix. Introduction to product design. Modern product development process. Innovative thinking. Morphology of design	8
Unit-2	Resource planning: Aggregate Production Planning – Chase and leveling strategies, MRP, MRP- II, Agile manufacturing Systems	6
Unit-3	OPERATIONAL PERFORMANCE Engine performance & operating characteristics, Operation at full load and part load conditions.	6
Unit-4	Fuel economy, effect of vehicle condition, tyre and road condition, traffic condition and driving habits on fuel economy, vehicle safety	8
Unit-5	CONTROL SYSTEMS Braking arrangements & Characteristics, weight transfer, steering arrangements, rigid & independent suspension, roll centre, torsion bar, stabilizer, radius bar.	8
Unit-6	VEHICLE TRANSMISSION PERFORMANCE Characteristics & features of friction clutches, mechanical gear transmission & Epicyclic gear boxes.	6
	Total	42

Refe	Reference Books:										
1	Martyr A. J, Plint M. A, "Engine Testing Theory and Practice" 3 rdeditionPublisherButterworth-Heinemann,										
	2007(ISBN -13: 9780768018509)										
2	Gousha H. M,"Engine Performance Diagnosis & Tune Up Shop Manual" PublisherCanfield press (ISBN										
	978006454										
3	Giles J. G, "Vehicle Operation & Performance" Publisher-Iliffe, 1969										
4	Crouse. W. H, Anglin. D. L, "Motor Vehicle Inspection", Publisher-McGraw Hill, (ISBN -13: 9780070148130										
	)1978										

CO1	To study Classification/ and Specifications of Products and Product life cycle
CO2	To discuss Resource planning: APP –MRP, MRP-II, Agile manufacturing Systems
CO3	To explain Engine performance & operating characteristics with different load conditions.
CO4	To describe fuel economy, tyre and road condition, traffic condition and vehicle safety
CO5	To analyze Braking, steering arrangements, rigid & independent suspension
CO6	To apply knowledge on friction clutches, mechanical gear transmission & Epicyclic gear boxes.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2