SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

FACULTY OF ENGINEERING AND TECHNOLOGY

CURRICULUM, PRE-REQUISITES/ CO-REQUISITES CHART AND SYLLABUS FOR B.TECH UNDER CHOICE BASED FLEXIBLE CREDIT SYSTEM

REGULATIONS 2015
(For students admitted from 2015-16 onwards)

Specialization **:** Automobile Engineering
Offering Department **:** Department of Automobile Engineering

Placed in the 32nd Academic Council Meeting held on 23rd July 2016

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STUDENT OUTCOMES

The curriculum and syllabus for B.Tech programs (2015) conform to outcome based teaching learning process. In general, ELEVEN STUDENT OUTCOMES (a-k) have been identified and the curriculum and syllabus have been structured in such a way that each of the courses meet one or more of these outcomes. Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. Further each course in the program spells out clear instructional objectives which are mapped to the student outcomes.

The student outcomes are:

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic
d) constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
e) an ability to function on multidisciplinary teams
f) an ability to identify, formulate, and solve engineering problems
g) an understanding of professional and ethical responsibility
h) an ability to communicate effectively
i) the broad education necessary to understand the impact of engineering solutions in
j) global, economic, environmental, and societal context
k) a recognition of the need for, and an ability to engage in life-long learning
l) a knowledge of contemporary issues
m) an ability to use the techniques, skills, and modern engineering tools necessary for
n) engineering practice.

C-D-I-O INITIATIVE

The CDIO Initiative (CDIO is a trademarked initialism for Conceive-Design-Implement-Operate) is an innovative educational framework for producing the next generation of engineers. The framework provides students with an education stressing engineering fundamentals set in the context of Conceiving-Designing-Implementing-Operating real world systems and products. Throughout the world, CDIO Initiative collaborators have adopted CDIO as the framework of their curricular planning and outcome-based assessment.

In the syllabus, every topic has been classified under one or more of C-D-I-O so that students and faculty alike are clear about the scope of learning to take place under each one of the topics.

SYMBOLS AND ABBREVIATIONS

AE	Automobile Engineering
B	Courses under Basic Science and Mathematics
BT	Biotechnology Courses
C-D-I-O	Conceive-Design-Implement-Operate
CE	Civil Engineering Courses
CS	Computer Science and Engineering Courses
CY	Chemistry Courses
Dept.	Department of Automobile Engineering
E with course code	Elective Courses
E	Courses under Engineering Sciences
EC	Electronics and Communication Engineering Courses
EE	Electrical and Electronics Engineering Courses
G	Courses under Arts and Humanities
IOs	Instructional Objectives
L	Laboratory / Project / Industrial Training Courses
LE	Language Courses
L-T-P-C	L- Lecture Hours Per Week
	T- Tutorial Hours Per Week
	P- Practical Hours Per Week
	C- Credits for a Course
M	Courses with Multi- Disciplinary Content
MA	Mathematics Courses
ME	Mechanical Engineering Courses
NC	NCC- National Cadet Corps
NS	NSS – National Service Scheme
P	Professional Core Courses
PD	Personality Development Courses
PY	Physics Courses

FACULTY OF ENGINEERING AND TECHNOLOGY, SRM UNIVERSITY

DEPARTMENT OF AUTOMOBILE ENGINEERING

B.TECH AUTOMOBILE ENGINEERING CHOICE BASED FLEXIBLE CREDIT SYSTEM (CBFCS) Curriculum Under Regulations 2015 (For students admitted from 2015-16 onwards)

L	Lecture Hours / Week	T Tutorial Hours / Week	C	Credits	P Practical Hours / Week	L	Laboratory Course	E Elective Courses	J	Theory jointly with Lab	M Course with Multidisciplinary content

Category	Category - wise % of Credits	Year 1												Year 2									
		1st Semester						2nd Semester						1st Semester						2nd Semester				
		Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C
Arts & Humanities-G	8.33%	15LE101	English	2	0	0	2	15LE102	Value Education	2	0	0	2	15LE201E	German Language-I	2	0	0	2	15LE207E	German Language-II	2	0	0	2
		15PD101	Soft Skills-I	1	1	0	1	15PD102	Soft Skills-II	1	1	0	1	15LE202E	French Language-I					15LE208E	French Language-II				
								15NC101	NCC- National Cadet Corps	0	0	1	1	15LE203E	Japanese Language-I					15LE209E	Japanese Language-II				
								15NS101	NSS- National Service Scheme					15LE204E	Korean Language-I					15LE210E	Korean Language-II				
								15SP101	NSO- National Sports Organization					15LE205E	Chinese Language-I					15LE211E	Chinese Language-II				
								15YG101	Yoga					15PD201	Quantitative Aptitude & Logical Reasoning –I	1	1	0	1	15PD202	Verbal Aptitude	1	1	0	1
	15		Total	3	1	0	3		Total	3	1	1	4		Total	3	1	0	3		Total	3	1	0	3
Basic Sciences - B	19.44%	15MA101	Calculus And Solid Geometry	3	1	0	4	15MA102	Advanced Calculus And Complex Analysis	3	1	0	4	15MA202	Fourier Series, Partial Differential Equations And Its Applications	4	0	0	4	15MA206	Numerical Methods	4	0	0	4
		15PY101	Physics	3	0	0	3	15PY102L	Material Science	2	0	2	3												
		15PY101L	Physics Laboratory	0	0	2	1	15CY102	Principles Of Environmental Science	2	0	0	2												
		15CY101	Chemistry	3	0	0	3																		
		15CY101L	Chemistry Laboratory	0	0	2	1																		
		15BT101	Biology For Engineers	2	0	0	2																		
	35		Total	11	1	4	14		Total	7	1	2	9		Total	4	0	0	4		Total	4	0	0	4
Engineering Sciences -E	10.00%	15CE101	Basic Civil Engineering	2	0	0	2	15ME101	Basic Mechanical Engineering	2	0	0	2	15ME201	Thermodynamics	2	2	0	3						
		15EE101	Basic Electrical Engineering	2	0	0	2	15EC101	Basic Electronics Engineering	2	0	0	2												
		15ME105L	Engineering Graphics	1	0	4	3	15ME104L	Workshop Practice	0	0	3	2												
		15CS101L	Programming Laboratory	1	0	2	2																		
	18		Total	6	0	6	9		Total	4	0	3	6		Total	2	2	0	3		Total	0	0	0	0
Professional - Core -P	38.89%							15ME102	Engineering Mechanics	3	1	0	4	15ME205	Fluid Mechanics	2	2	0	3	15AE204	Applied Thermal Engineering for Automotive Engineers	2	2	0	3
								15AE101L	Artifact Dissection	0	0	2	1	15AE201J	Manufacturing Technology for Automotive Engineers	3	0	2	4	15ME203	Mechanics of Solids	2	2	0	3
														15AE202	Sensors,Actuators and Signal Conditioners	2	0	0	2	15ME204	Machines and Mechanisms	2	2	0	3
														15AE203L	Automotive Components and Assembly Drawing	0	1	3	2	15ME303	Materials Technology	3	0	0	3
														15ME205L	Fluid Dynamics Laboratory	0	0	2	1	15ME303L	Materials Technology Laboratory	0	0	2	1
																				15ME203L	Strength of Materials Laboratory	0	0	2	1
	70		Total	0	0	0	0		Total	3	1	2	5		Total	7	3	7	12		Total	9	6	4	14
Prof - Electives -P	8.33%																				**Department Elective-I**	**3**	**0**	**0**	**3**
	18		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0		Total	3	0	0	3
Project / Seminar / Internship-	8.33%																			15AE375L / 15AE380L / 15AE385L / 15AE490L	Minor Project I / Seminar I / Massive Open Online Courses (MOOCs) I / Industrial Module I	0	0	3	2
	18		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	3	2
Open Electives	`																								
	6		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0
Total	**180**			**20**	**2**	**10**	**26**			**17**	**3**	**8**	**24**			**16**	**6**	**7**	**22**			**19**	**7**	**7**	**26**
			Contact hours	**32**					**Contact hours**	**28**					**Total contact hours**	**29**					**Total Contact hours**	**33**			

B.TECH AUTOMOBILE ENGINEERING CHOICE BASED FLEXIBLE CREDIT SYSTEM (CBFCS) Curriculum Under Regulations 2015 (For students admitted from 2015-16 onwards)

L	Lecture Hours / Week	T	Tutorial Hours / Week	C Credits P Practical Hours / Week	L	Laboratory Course	E Elective Courses	J	Theory jointly with Lab	M Course with Multidisciplinary content

	Year 3											Year 4									
	1st Semester					2nd Semester						1st Semester					2nd Semester				
Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C
15PD301	Communication & Reasoning Skills	1	1	0	1	15PD302	Quantitative Aptitude & Logical Reasoning –II	1	1	0	1										
	Total	1	1	0	1		Total	1	1	0	1		Total	0	0	0	0		Total	0	0	0	0
15MA301	Probability and Statistics	4	0	0	4																
	Total	4	0	0	4		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0
	Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0
	Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0
15AE301	Design of Automotive Components	2	2	0	3	15ME304	Fluid Power Control	3	0	0	3	15AE401	Vehicle Dynamics	2	2	0	3				
15AE302	Automotive Chassis	2	2	0	3	15AE308J	CAD Analysis for Automotive Engineers	3	0	2	4	15AE402	Vehicle Body Engineering and Aerodynamics	3	0	0	3				
15AE303	Automotive Engines	3	0	0	3	15AE307J	Automotive Electrical & Electronic System	3	0	2	4	15AE403	Alternative Fuels and Emission Control	3	0	0	3				
15AE304L	Engine and Fuel Testing Laboratory	0	0	2	1	15AE309	Automotive Transmission	2	2	0	3	15AE404M	Multi-Disciplinary Design	2	2	0	3				
15AE305L	Automotive Components Laboratory	0	0	2	1							15AE401L	Vehicle Dynamics Laboratory	0	0	2	1				
												15AE405L	Vehicle Testing Laboratory	0	0	2	1				
	Total	7	4	4	11		Total	11	2	4	14		Total	10	4	4	14		Total	0	0	0	0
	Department Elective-II	**3**	**0**	**0**	**3**		**Department Elective-III**	**3**	**0**	**0**	**3**		**Department Elective-IV**	**3**	**0**	**0**	**3**				
													Department Elective-V	**3**	**0**	**0**	**3**				
													Department Elective-VI	**3**	**0**	**0**	**3**				
	Total	3	0	0	3		Total	3	0	0	3		Total	9	0	0	9		Total	0	0	0	0
15AE390L	Industrial Training-I (To be done after IV semester)	0	0	2	1	15AE376L / 15AE381L / 15AE386L / 15AE491L	Minor Project II / Seminar II / Massive Open Online Courses (MOOCs) II / Industrial Module II	0	0	3	2	15AE391L	Industrial Training-II (To be done after VI semester)	0	0	2	1	15AE496L	Major Project	0	0	24	12
	Total	0	0	2	1		Total	0	0	3	2		Total	0	0	2	1		Total	0	0	24	12
	Open Elective I	3	0	0	3		Open Elective II	3	0	0	3										
	As per list / as taken by the student						As per list / as taken by the student														
	Total	3	0	0	3		Total	3	0	0	3		Total	0	0	0	0		Total	0	0	0	0
		18	**5**	**6**	**23**			**18**	**3**	**7**	**23**			**19**	**4**	**6**	**24**			**0**	**0**	**24**	**12**
	Total Contact hours	**29**					**Total contact hours**	**28**					**Total contact hours**	**29**					**Total contact hours**	**24**			

B.Tech Automobile Engineering (Regulations 2015)							B.Tech Automobile Engineering (Regulations 2015)						
List of Department Electives							List of Department Electives						
COURSE CODE	**Course Title**	**L**	**T**	**P**	**C**		**COURSE CODE**	**Course Title**	**L**	**T**	**P**	**C**	
15AE221E	Welding and Joining Techniques	3	0	0	3		15AE421E	Computer Integrated Manufacturing	3	0	0	3	
15AE222E	Automotive Component Manufacturing	3	0	0	3		15AE431E	Automotive Safety and Ergonomics	3	0	0	3	
15AE251E	Automotive Control Systems	3	0	0	3		15AE432E	Vehicle Maintenance	3	0	0	3	
15AE252E	Microcontrollers for Automotive applications	3	0	0	3		15AE441E	Vehicle Design Data Characteristics	3	0	0	3	
15AE321E	Non Destructive Testing Methods	3	0	0	3		15AE451E	Intelligent Vehicle Technology	3	0	0	3	
15AE322E	Composite Materials and Structures	3	0	0	3		15AE461E	Simulation of IC Engines	3	0	0	3	
15AE323E	Non Traditional Machining Techniques	3	0	0	3		15AE422E	Process Planning and Cost Estimation	3	0	0	3	
15AE331E	Auxiliary Vehicle Systems	3	0	0	3		15AE433E	Tyre Technology	3	0	0	3	
15AE332E	Automotive NVH	3	0	0	3		15AE442E	Finite Element Analysis	3	0	0	3	
15AE333E	Two and Three Wheeler Technology	3	0	0	3		15AE452E	Model Based System Design	3	0	0	3	
15AE341E	Automotive Driveline Design	3	0	0	3		15AE462E	Automotive Emission formation and controls	3	0	0	3	
15AE342E	Design for Safety and Comfort	3	0	0	3		15AE463E	Fuel Testing and Standards	3	0	0	3	
15AE351E	Automotive Fault Diagnostics	3	0	0	3		15AE423E	Manufacturing Systems & Simulation	3	0	0	3	
15AE352E	Automotive Communication Protocols	3	0	0	3		15AE424E	Automotive Quality System	3	0	0	3	
15AE361E	HVAC	3	0	0	3		15AE434E	Automotive Standards and Regulations	3	0	0	3	
15AE362E	Design of Automotive Thermal Systems	3	0	0	3		15AE435E	Motorsport Technology	3	0	0	3	
15AE324E	Industrial Engineering and Operational Research	3	0	0	3		15AE443E	Concepts of Engineering Design	3	0	0	3	
15AE325E	Agile Manufacturing (Lean)	3	0	0	3		15AE453E	Vehicle Stability and Control Systems	3	0	0	3	
15AE326E	Advanced Manufacturing Process	3	0	0	3		15AE464E	Automotive Exhaust System Development	3	0	0	3	
15AE334E	Special Types of Vehicles	3	0	0	3		15AE465E	Engine Auxiliary Systems	3	0	0	3	
15AE335E	Vehicle Performance and Testing	3	0	0	3								
15AE336E	Advanced Vehicle Technology	3	0	0	3								
15AE343E	Design for Race Cars	3	0	0	3								
15AE344E	New Product Development	3	0	0	3								
15AE345E	Automotive Chassis Component Design	3	0	0	3								
15AE353E	Artificial Neural Networks and Fuzzy Logic	3	0	0	3								
15AE354E	Electric and Hybrid Vehicles	3	0	0	3								
15AE363E	Engine Testing and Validation	3	0	0	3								
15AE364E	Advanced Engine Technology	3	0	0	3								

B.Tech Automobile Engineering
(Applicable for Students Admitted from the Academic Year 2015-2016 Onwards)
CURRICULUM – 2015

Semester I						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
15LE101	G	English	2	0	0	2
15PD101	G	Soft Skills-I	1	1	0	1
15MA101	B	Calculus and Solid Geometry	3	1	0	4
15PY101	B	Physics	3	0	0	3
15CY101	B	Chemistry	3	0	0	3
15BT101	B	Biology for Engineers	2	0	0	2
15CE101	E	Basic Civil Engineering	2	0	0	2
15EE101	E	Basic Electrical Engineering	2	0	0	2
15PY101L	B	Physics Laboratory	0	0	2	1
15CY101L	B	Chemistry Laboratory	0	0	2	1
15ME105L	E	Engineering Graphics	1	0	4	3
15CS101L	E	Programming Laboratory	1	0	2	2
Total			**20**	**2**	**10**	**26**
Total Contact Hours			**32**			

Semester II						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
15LE102	G	Value Education	2	0	0	2
15PD102	G	Soft Skills-II	1	1	0	1
15MA102	B	Advanced Calculus and Complex Analysis	3	1	0	4
15PY102L	B	Material Science	2	0	2	3
15CY102	B	Principles of Environmental Science	2	0	0	2
15ME101	E	Basic Mechanical Engineering	2	0	0	2
15EC101	E	Basic Electronics Engineering	2	0	0	2
15ME102	P	Engineering Mechanics	3	1	0	4
15ME104L	E	Workshop Practice	0	0	3	2
15AE101L	P	Artifact Dissection	0	0	2	1
15NC101/ 15NS101/ 15SP101/ 15YG101	G	*NCC /NSS/NSO/YOGA	0	0	1	1
Total			**17**	**3**	**8**	**24**
Total Contact Hours			**28**			

*NCC – National Cadet Corps
NSS – National Service Scheme
NSO – National Sport Organization

Legend:
L - Number of lecture hours per week
T - Number of tutorial hours per week
P - Number of practical hours per week
C - Number of credits for the course

Category of courses:
G – General
B - Basic Sciences
E - Engineering Sciences and Technical Arts
P - Professional Subjects

Semester III						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
15LE201E/ 15LE202E/ 15LE203E/ 15LE204E/ 15LE205E	G	German Language - I/ French Language - I/ Japanese Language - I/ Korean Language -I/ Chinese Language - I	2	0	0	2
15PD201	G	Quantitative Aptitude & Logical Reasoning – I	1	1	0	1
15MA202	B	Fourier Series, Partial Differential Equations and its Applications	4	0	0	4
15ME201	E	Thermodynamics	2	2	0	3
15ME205	P	Fluid Mechanics	2	2	0	3
15AE201J	P	Manufacturing Technology for Automotive Engineers	3	0	2	4
15AE202	P	Sensors, Actuators and Signal Conditioners	2	0	0	2
15AE203L	P	Automotive Components and Assembly Drawing	0	1	3	2
15ME205L	P	Fluid Dynamics Laboratory	0	0	2	1
Total			**16**	**6**	**7**	**22**
Total Contact Hours			**29**			

Semester IV						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
15LE207E/ 15LE208E/ 15LE209E/ 15LE210E/ 15LE211E	G	German Language -II/ French Language -II/ Japanese Language -II/ Korean Language -II/ Chinese Language- II	2	0	0	2
15PD202	G	Verbal Aptitude	1	1	0	1
15MA206	B	Numerical Methods	4	0	0	4
15AE204	P	Applied Thermal Engineering for Automotive Engineers	2	2	0	3
15ME203	P	Mechanics of Solids	2	2	0	3
15ME204	P	Machines and Mechanisms	2	2	0	3
15ME303	P	Materials Technology	3	0	0	3
15ME203L	P	Strength of Materials Laboratory	0	0	2	1
15ME303L	P	Materials Technology Laboratory	0	0	2	1
15AE375L/ 15AE380L/ 15AE385L/ 15AE490L	P	Minor Project- I/ Seminar- I/ Massive Open Online Courses (MOOCs)-I/ Industrial Module- I	0	0	3	2
	P	Departmental Elective – I	3	0	0	3
Total			**19**	**7**	**7**	**26**
Total Contact Hours			**33**			

Semester V						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
15PD301	G	Communication & Reasoning Skills	1	1	0	1
15MA301	B	Probability and Statistics	4	0	0	4
15AE301	P	Design of Automotive Components	2	2	0	3
15AE302	P	Automotive Chassis	2	2	0	3
15AE303	P	Automotive Engines	3	0	0	3
15AE304L	P	Engine and Fuel Testing Laboratory	0	0	2	1
15AE305L	P	Automotive Components Laboratory	0	0	2	1
15AE390L	P	Industrial Training -I (To be done after IV Semester)	0	0	2	1
	P	Department Elective-II	3	0	0	3
	P	Open Elective -I	3	0	0	3
Total			**18**	**5**	**6**	**23**
Total Contact Hours			**29**			

Semester VI						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
15PD302	G	Quantitative Aptitude & Logical Reasoning – II	1	1	0	1
15ME304	P	Fluid Power Control	3	0	0	3
15AE308J	P	CAD Analysis for Automotive Engineers	3	0	2	4
15AE307J	P	Automotive Electrical & Electronics System	3	0	2	4
15AE309	P	Automotive Transmission	2	2	0	3
15AE376L/ 15AE381L/ 15AE386L/ 15AE491L	P	Minor Project- II/ Seminar -II/ Massive Open Online Courses (MOOCs) -II/ Industrial Module-II	0	0	3	2
	P	Departmental Elective – III	3	0	0	3
	P	Open Elective – II	3	0	0	3
Total			**18**	**3**	**7**	**23**
Total Contact Hours			**28**			

Semester VII						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
15AE401	P	Vehicle Dynamics	2	2	0	3
15AE402	P	Vehicle Body Engineering and Aerodynamics	3	0	0	3
15AE403	P	Alternative Fuels and Emission Control	3	0	0	3
15AE404M	P	Multi-Disciplinary Design	2	2	0	3
15AE401L	P	Vehicle Dynamics Laboratory	0	0	2	1
15AE405L	P	Vehicle Testing Laboratory	0	0	2	1
15AE391L	P	Industrial Training –II (To be done after VI Semester)	0	0	2	1
	P	Departmental Elective – IV	3	0	0	3
	P	Departmental Elective – V	3	0	0	3
	P	Departmental Elective – VI	3	0	0	3
Total			**19**	**4**	**6**	**24**
Total Contact Hours			**29**			

Semester VIII						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
15AE496L	P	Major Project	0	0	24	12
Total			**0**	**0**	**24**	**12**
Total Hours			**24**			

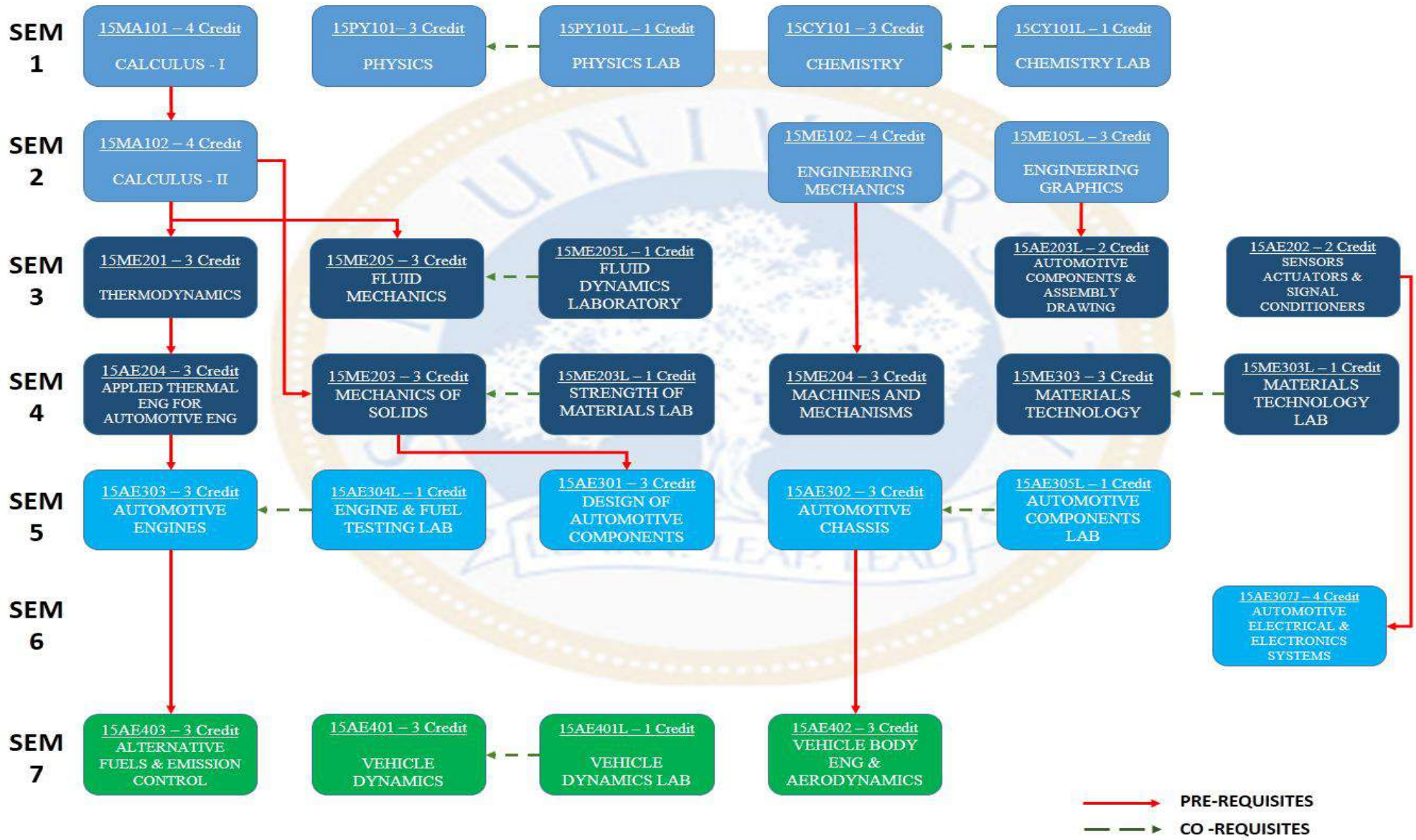
Departmental Electives

Course Code	Category	Course Name	L	T	P	C
Manufacturing						
15AE221E	P	Welding and Joining Techniques	3	0	0	3
15AE222E	P	Automotive Component Manufacturing	3	0	0	3
15AE321E	P	Non Destructive Testing Methods	3	0	0	3
15AE322E	P	Composite Materials and Structures	3	0	0	3
15AE323E	P	Non Traditional Machining Techniques	3	0	0	3
15AE324E	P	Industrial Engineering and Operational Research	3	0	0	3
15AE325E	P	Agile Manufacturing (Lean)	3	0	0	3
15AE326E	P	Advanced Manufacturing Process	3	0	0	3
15AE421E	P	Computer Integrated Manufacturing	3	0	0	3
15AE422E	P	Process Planning and Cost Estimation	3	0	0	3
15AE423E	P	Manufacturing Systems & Simulation	3	0	0	3
15AE424E	P	Automotive Quality System	3	0	0	3
Vehicle Technology						
15AE331E	P	Auxiliary Vehicle Systems	3	0	0	3
15AE332E	P	Automotive NVH	3	0	0	3
15AE333E	P	Two and Three Wheeler Technology	3	0	0	3
15AE334E	P	Special Types of Vehicles	3	0	0	3
15AE335E	P	Vehicle Performance and Testing	3	0	0	3
15AE336E	P	Advanced Vehicle Technology	3	0	0	3
15AE431E	P	Automotive Safety and Ergonomics	3	0	0	3
15AE432E	P	Vehicle Maintenance	3	0	0	3
15AE433E	P	Tyre Technology	3	0	0	3
15AE434E	P	Automotive Standards and Regulations	3	0	0	3
15AE435E	P	Motorsport Technology	3	0	0	3
Design						
15AE341E	P	Automotive Driveline Design	3	0	0	3
15AE342E	P	Design for Safety and Comfort	3	0	0	3
15AE343E	P	Design for Race Cars	3	0	0	3
15AE344E	P	New Product Development	3	0	0	3
15AE345E	P	Automotive Chassis Component Design	3	0	0	3
15AE441E	P	Vehicle Design Data Characteristics	3	0	0	3
15AE442E	P	Finite Element Analysis	3	0	0	3
15AE443E	P	Concepts of Engineering Design	3	0	0	3
Vehicular Electronics and Control Technology						
15AE251E	P	Automotive Control Systems	3	0	0	3
15AE252E	P	Microcontrollers for Automotive Applications	3	0	0	3
15AE351E	P	Automotive Fault Diagnostics	3	0	0	3
15AE352E	P	Automotive Communication Protocols	3	0	0	3
15AE353E	P	Artificial Neural Networks and Fuzzy Logic	3	0	0	3
15AE354E	P	Electric and Hybrid Vehicles	3	0	0	3
15AE451E	P	Intelligent Vehicle Technology	3	0	0	3
15AE452E	P	Model Based System Design	3	0	0	3
15AE453E	P	Vehicle Stability and Control Systems	3	0	0	3
Engine						
15AE361E	P	HVAC	3	0	0	3
15AE362E	P	Design of Automotive Thermal Systems	3	0	0	3
15AE363E	P	Engine Testing and Validation	3	0	0	3
15AE364E	P	Advanced Engine Technology	3	0	0	3
15AE461E	P	Simulation of IC Engines	3	0	0	3
15AE462E	P	Automotive Emission Formation and Controls	3	0	0	3
15AE463E	P	Fuel Testing and Standards	3	0	0	3
15AE464E	P	Automotive Exhaust System Development	3	0	0	3
15AE465E	P	Engine Auxiliary Systems	3	0	0	3

Note: All Core/Elective courses can be listed / delisted every semester under open electives, based on the availability of resources and demand.

Summary of Credits						
Category	**I&II**	**III&IV**	**V&VI**	**VII&VIII**	**Total**	**%**
G	7	6	2	0	15	8.33
B	23	8	4	0	35	19.44
E	15	3	0	0	18	10
P	5	28	28	27	88	48.89
Open Elective	0	0	6	0	6	3.33
Departmental Elective	0	3	6	9	18	10
Total	50	48	46	36	180	100

DEPARTMENT OF AUTOMOBILE ENGINEERING



DEPARTMENT OF AUTOMOBILE ENGINEERING

DEPARTMENTAL ELECTIVE LIST

DEPARTMENT OF AUTOMOBILE ENGINEERING			
Course Code	**Course title**	**Pre-requisites**	**Co-requisites**
SEMESTER - I			
15PD101	Soft Skills		
15MA101	Calculus And Solid Geometry		
15PY101	Physics		
15PY101L	Physics Lab		15PY101
15CS101L	Programming Lab		
15CY101	Chemistry		
15CY101L	Chemistry Lab		15CY101
15BT101	Biology For Engineers		
15EE101	Basic Electrical Engineering		
15CE101	Basic Civil Engineering		
SEMESTER - II			
15LE101	English		
15LE102	Value Education		
15PD102	Soft Skills - II		
15NC/NS/SP/YG101	NSS/NCC/Yoga/Sports		
15MA102	Advanced Calculus And Complex Analysis	15MA101	
15PY102	Material Science		
15CY102	Principles Of Environmental Science		
15EC101	Basic Electronics Engineering		
15ME101	Basic Mechanical Engineering		
15ME104L	Workshop Practice		
15ME105L	Engineering Graphics		
15ME102	Engineering Mechanics		
15AE101L	Artifact Dissection		
SEMESTER - III			
	Language		
15PD201	Aptitude		
15MA202	Fourier Series, Partial Differential Eqn & Its Applications		
15ME201	Thermodynamics	15MA102	
15ME205	Fluid Mechanics	15MA102	
15AE201J	Manufacturing Technology For Automotive Engineers		
15AE202	Sensors Actuators And Signal Conditioners		
15AE203L	Automotive Components Assembly Drawing	15ME105L	
15ME205L	Fluid Dynamics Lab		15ME205
SEMESTER - IV			
	Language		
15PD202	Aptitude-II		
15MA206	Numerical Methods		
15ME203	Mechanics Of Solids	15MA102	
15ME303	Materials Technology		
15ME204	Machines And Mechanisms	15ME102	
15AE204	Applied Thermal Engineering For Automotive Engineers	15ME201	
15ME203L	Strength Of Materials Laboratory		15ME203
15ME303L	Materials Technology Laboratory		15ME303
15AE375L	Minor Project I		
15AE380L	Seminar I		
15AE385L	MOOCs I		
15AE490L	Industry Modules I		
	Dep Elective I		
SEMESTER - V			
15PD301	Aptitude-III		
15MA301	Probability And Statistics		
15AE301	Design Of Automotive Components	15ME203	
15AE302	Automotive Chassis		
15AE303	Automotive Engines	15AE204	

15AE304L	Engine And Fuel Testing Laboratory		15AE303
15AE305L	Automotive Components Laboratory		15AE302
15AE390L	Industrial TrainingI		
	Dep Elective - II		
	Open Elective - I		
SEMESTER - VI			
15PD302	Aptitude - IV		
15ME304	Fluid Power Control		
15AE307J	Automotive Electrical And Electronic Systems	15AE202	
15AE308J	Cad Analysis For Automotive Engineers		
15AE309	Automotive Transmission		
15AE375L/ 15AE381L/ 15AE386L/ 15AE491L	Minor Project-II Seminar-II Massive Open Online Courses (MOOCs)-II Industrial Module -II		
	Dep Elective - III		
	Open Elective - II		
SEMESTER - VII			
15AE401	Vehicle Dynamics		
15AE402	Vehicle Body Engineering And Aerodynamics	15AE302	
15AE403	Alternative Fuels And Emission Control	15AE303	
15AE404M	Multi Disciplinary Design		
15AE401L	Vehicle Dynamics Laboratory		15AE401
15AE405L	Vehicle Testing Laboratory		
15AE391L	Industrial Training II		
	Dep.Elective IV		
	Dep.Elective V		
	Dep.Elective VI		
SEMESTER - VIII			
15AE496L	Major Project/Practice School		

DEPARTMENT OF AUTOMOBILE ENGINEERING DEPARTMENTAL ELECTIVES			
Course Code	**Course Title**	**Pre-requisites**	**Co-requisites**
DESIGN			
15AE341E	Automotive Driveline Design		
15AE342E	Design For Safety And Comfort		
15AE343E	Design For Race Cars		
15AE344E	New Product Development	15AE301	
15AE345E	Automotive Chassis Component Design	15AE301	
15AE441E	Vehicle Design Data Characteristics	15AE301	
15AE442E	Finite Element Analysis	15ME203 15ME204	
15AE443E	Concept Of Engineering Design		
MANUFACTURING			
15AE221E	Welding And Joining Techniques		
15AE222E	Automotive Component Manufacturing		
15AE321E	Non Destructive Testing		
15AE322E	Composite Materials And Structures		
15AE323E	Non Traditional Machining Techniques	15AE201J	
15AE324E	Industrial Engineering And Operations Research		
15AE325E	Agile Manufacturing		
15AE326E	Advanced Manufacturing Process	15AE201J	
15AE421E	Computer Integrated Manufacturing		
15AE422E	Process Planning And Cost Estimation	15AE201J	
15AE423E	Manufacturing Systems And Simulation	15AE201J	
15AE424E	Automotive Quality System		
VEHICLE TECHNOLOGY			
15AE331E	Auxiliary Vehicle Systems		
15AE332E	Automotive NVH		
15AE333E	Two And Three Wheeler Technology		
15AE334E	Special Types Of Vehicles		
15AE335E	Vehicle Performance And Testing	15AE303	
15AE336E	Advanced Vehicle Technology		
15AE431E	Automotive Safety And Ergonomics		
15AE432E	Vehicle Maintenance		
15AE433E	Tyre Technology		
15AE434E	Automotive Standards And Regulations		
15AE435E	Motorsport Technology		
ENGINE			
15AE361E	HVAC	15AE204	
15AE362E	Design Of Automotive Thermal System	15AE204	
15AE363E	Engine Testing And Validation		
15AE364E	Advanced Engine Technology		
15AE461E	Simulation Of IC Engine	15AE303	
15AE462E	Automotive Emission Formation And Control	15AE303	
15AE463E	Fuel Testing And Standards		
15AE464E	Automotive Exhaust System Development	15AE303	
15AE465E	Engine Auxiliary Systems	15AE303	
VEHICULAR ELECTRONICS AND CONTROL TECHNOLOGY			
15AE251E	Automotive Control System	15AE202	
15AE252E	Microcontrollers For Automotive Applications	15AE202	
15AE351E	Automotive Fault Diagnostics		
15AE352E	Automotive Communication Protocols	15AE252E	
15AE353E	Artificial Neural Network And Fuzzy Logic		
15AE354E	Electric And Hybrid Vehicle		
15AE451E	Intelligent Vehicle Technology		
15AE452E	Model Based System Design	15AE251E	
15AE453E	Vehicle Stability And Control	15AE251E	

Semester II

15AE101L	Artifact Dissection	L	T	P	C
		0	0	2	1
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P	Professional Core			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To develop skills in designing and conducting experiments related to applications of principles of physics in engineering			
Instructional Objectives		**Student Outcomes**		
At the end of the course, student will be able to				
1.	Design and conduct experiments, as well as to analyze and interpret data	b		
2.	Equip themselves familiar with functions of several components.	b		

Sl. No.	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Study of Basic Tools.	4	C,I	1,2	1-3
2.	Dismantling and Assembling of the given Bicycle.	4	I,O	1,2	1,2
3.	Dismantling and Assembling of the given Sewing Machine.	4	I,O	1,2	1,2
4.	Dismantling and Assembly of the given Hand Drilling Machine.	4	I,O	1,2	1,2
5.	Dismantling and Assembling of Piston Assembly from the given 2-S IC Engine.	4	I,O	1,2	1,3
6.	Dismantling and Assembling of Kick Starter Assembly from the given 2-S IC Engine.	4	I,O	1,2	1,3
	Total Contact Hours	**24**			

Learning Resources	
Sl. No.	**References**
1.	Laboratory Manual
2.	Bhandari. V. B., "*Design of Machine Elements*", Tata McGraw-Hill Publishing Company Ltd, 2010.
3.	M.L Mathur and R.P.Sharma, "*A Course in Internal Combustion Engines*", Dhanpat Rai Publications, 2010.

Course Nature				**Practical**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination	**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**	**60%**
					End semester examination Weightage :	**40%**

Semester III

15AE201J	Manufacturing Technology For Automotive Engineers			L	T	P	C
				3	0	2	4
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Manufacturing Engineering				
Course designed by	Department Of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire knowledge of various manufacturing processes and machine tools and also familiarize the process parameters and coating techniques.

Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Recommend appropriate part manufacturing processes when provided a set of functional requirements and product development constraints.	a			
2.	Fabricate basic parts and assemblies using powered and non-powered machine shop equipments.	a	c		
3.	Solve problems on cutting forces, tool life and analytical methods of estimating cutting temperature	a	c	e	

Session	Description of Topic	Contact Hours	C-D-I-O	IOs	Reference
	Unit I: Introduction To Manufacturing and Casting Process	**09**			
1.	Introduction to manufacturing- examples of manufactured products, global competitiveness and manufacturing cost, environmentally conscious design and manufacturing , organization for manufacture	1	C	1	1
2.	Material properties , material selection, selecting manufacturing processes	1	C	1	1
3.	Casting introduction, pattern material, types, allowances	1	C	1	1
4.	Expandable mold- sand, shell, plaster, ceramic and investment	2	C	1	1
5.	Permanent mold casting – Slush, pressure, die, centrifugal, squeeze Core – core making.	2	C	1	1
6.	Design of runner, riser, gating and sprue	1	C,D	1	1
7.	Solidification time, shrinkage allowance and casting defects	1	C,D	1	1
8.	**Unit II: Shaping and Forming Processes**	**8**			
9.	Forging – Types of presses and hammers , Forging processes	1	C	2	3,5
10.	Forging loads calculation and Forging defects	1	C,D	2	3,5
11.	Rolling –Rolling of blooms, billets, slabs and sheet, types of rolling mills, Forces and geometrical relationship in rolling and rolled defects	1	C	2	3,5
12.	Extrusion process, hot and cold extrusion, types and defects	1	C	2	3,5
13.	Wire and tube drawing, Drawing force calculation and Defects	1	C,D	2	3,5
14.	Sheet Metal Operations – Shearing, Slitting, fine blanking, Nibbling, Tailor welded blanks, perforating	1	C	2	3,5
15.	Theory of bending, types of bending operation, bending load calculations, bending defects.	1	C,D	2	3,5
16.	Stretch forming, Deep drawing, Ironing, Seaming and Spinning process	1	C	2	3,5
17.	**Unit III: Machining of Axi-Symmetrical Components**	**8**			
18.	Mechanics of chip formation and Types of chips	1	C	3	2
19.	Calculation of cutting force, power, temperatures in cutting	1	C,D	3	2
20.	Cutting tool materials ,Tool signature for single point and multi point cutting Tool and Tool life calculation	1	C,D	4	2
21.	Types of lathe machines , specifications and chip collection systems	1	C	4	2

22.	Work holding devices, Cutting fluids and Machinability	1	C	4	2
23.	External Surface machining and Internal Surface machining	2	C	4	2
24.	Design consideration in turning operations, Material Removal Rate and cutting forces	1	C,D	4	2
25.	**Unit IV – Machining of Prismatic Components And Gear Manufacturing**	**8**			
26.	Milling machines and types	1	C	4	3
27.	Work holding devices and Milling cutters	1	C	5	3
28.	Milling Operations	1	C	4	3
29.	Operating Parameters – cutting speed, feed, depth of cut	1	C	4	3
30.	Material removal rate, Accuracy and surface finish	1	C,D	4	3
31.	Machining time calculation	1	C,D	4	3
32.	Gear hobbing and gear shaping machines	1	C	4	3
33.	Tooling and selection of cutting parameters	1	C	4	3
34.	**Unit V – Surface Finishing and Treatments**	**8**			
35.	Grinding machines and types - surface, cylindrical, internal and centerless grinder	1	C	4	4
36.	Specification of grinding wheels	1	C	4	4
37.	Operating parameters - accuracy, surface finish attainable by various processes	1	C	4	4
38.	Lapping- Introduction, Processes, Automotive Applications	1	C	4	4
39.	Honing- Introduction, Processes, Automotive Applications	1	C	4	4
40.	Super finishing process- Introduction, Processes, Automotive Applications	1	C	4	4
41.	Protective and decorative coatings- Introduction, Processes, Automotive Applications.	2	C	4	4
42.	Cycle test-I	1			
43.	Cycle test-II	2			
44.	Surprise test	1			
	Total Contact Hours	**45**			

Sl. No.	Description Of Experiments (Practical)	Contact hours	C,D,I,O	IOs	Reference
1.	Introduction- lathe machine, plain turning, Step turning & grooving (Including lathe mechanisms, simple problems).	4	C,I,O	4	4
2.	Taper turning-compound rest/offset method & Drilling using lathe (Including Drilling feed mechanism, Twist drill nomenclature).	4	I,O	4	4
3.	External threading-Single start, (Including Thread cutting mechanism-simple problems)	2	I,O	4	4
4.	Eccentric turning-Single axis	2	I,O	4	4
5.	Shaping-V-Block (Including Shaper quick return mechanism).	2	I,O	4	4
6.	Grinding-Cylindrical /Surface/Tool & cutter	2	I,O	4	4
7.	Slotting-Keyways (Including Broaching tool nomenclature and Slotter mechanism).	2	I,O	4	4
8.	Milling- Spur gear (Including Milling mechanism, simple problems)	4	I,O	4	4
9.	Drilling operations	2	I,O	4	4
10.	Application oriented products using above experiments.	6	I,O	4	4
	Total Contact Hours	**30**			

Learning Resources	
Sl. No.	**Text Books**
1.	Serop Kalpakjian and Steven Schmid, *"Manufacturing Engineering and Technology"*, Pearson Education, New Delhi, 2005
2.	Mikel P Groover, *"Fundamentals of Modern Manufacturing",* John Wiley & Sons, New Delhi, 2007.
	Reference Books/Other Reading Material
3.	P N Rao, *"Manufacturing Technology - Machining and Machine Tools"*, Tata McGraw Hill, New Delhi, 2000.
4.	Sharma P C, *"A Text Book of Production Technology - Manufacturing Processes",* S Chand & Company, New Delhi, 2007.
5.	Nagpal G R, *"Metal Forming Processes",* Khanna Publishers, New Delhi, 2000.

Course Nature				Theory + Practical			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	**Experiments**	**Record**	**MCQ/Quiz/Viva Voce**	**Model examination**		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
						End semester examination Weightage :	**40%**

15AE202	**Sensors, Actuators and Signal Conditioners**			**L**	**T**	**P**	**C**
				2	**0**	**0**	**2**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Vehicular Electronics & Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To understand the importance and use of actuators, sensors and signal conditioning for automotive applications.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand the working principles of Automotive Sensors	a	b	d	
2.	Understand the working principles of actuators for automotive control application	a	b	d	
3.	Understand the basics of Linear OP-AMP	a	b		
4.	Design Differentiator, Integrator, Clipper, Clampers using OP-AMP	a	b	c	
5.	Design Waveform Generators, A/D and D/A convertors	a	b	c	

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Automotive Sensors	**5**			
1.	Introduction to sensors and variables to be measured in an automotive measurement and control applications.	1	C	1	1
2.	Airflow Rate Sensor, Pressure Measurement –Strain gauge MAP sensor.	1	C	1	1
3.	Engine Crank Position sensor-Magnetic reluctance, Hall effect and optical crank position sensor	1	C,D	1	1
4.	Throttle angle sensor, Temperature Sensor.	1	C,D	1	1
5.	Sensors for Engine feedback control – EGO sensor, EGO characteristics, Magneto strictive principle and Knock sensor.	1	C	1	1
	Unit II: Automotive Actuators	**5**			
6.	Introduction to actuators and variables to be controlled, Engine control actuators.	1	C	2	1
7.	Pulse width Modulated signal and H-bridge device for speed and direction control.	1	C	2	1
8.	Electric motor actuator –DC motor, Brushless DC Motor, Stepper Motor and Servomechanism.	1	C,D	2	1
9.	Engine control actuators-Fuel injector (solenoid, Piezo electric type), Ignition coil operation, EGR Actuator, Electric actuators- Relays, Reed switch.	2	C,D	2	1
	Unit III: Introduction To Op-Amp	**6**			
10.	OP-Amp: Introduction, Basics, Ideal OP-AMP	1	C	3	1,2
11.	Open Loop and feedback in OP-AMP operation, Inverting and non-inverting amplifier.	1	C,D	3	1,2

12.	Voltage follower and Differential amplifiers.	1	C,D	3	2
13.	Difference mode, Common mode gain, CMRR	1	C	3	2
14.	Operation amplifier internal circuit, Example of OP-AMP IC's (IC 741)	1	C	3	2
15.	OP-Amp D.C characteristics	1	C	3	2
	Unit IV:Operational Amplifier Applications	**5**			
16.	Basic OP-AMP applications, Instrumentation amplifier	1	C	3	2
17.	OP-Amp circuit using diodes, Sample and Hold circuit, V-I and I-V convertor,	2	C,D	3,4	2
18.	Multiplier, Divider, Integrator and Differentiator	2	C,D	4	2
	Unit V: Waveform Generators, A/D And D/A Convertors	**5**			
19.	Comparator and its application	1	D,I	4,5	2
20.	Regenerative comparator and square wave generator (Astable multivibrator)	1	C	5	2
21.	Basic DAC techniques –Weighted resistor,R-2R ladder and inverted R-2R ladder	1	C	5	2
22.	ADC-Direct Type ADC's –Flash ADC, Successive approximation ADC	2	C,D	5	2
23.	Cycle test-I	1			
24.	Cycle test-II	2			
25.	Surprise test	1			
	Total Contact Hours	**30**			

Learning Resources	
Sl. No.	**Text Books**
1.	William. B. Ribbens, *"Understanding Automotive Electronics"* 7th Edition Butterworth-Heinemann publications, 2012.
2.	D.Roy Choudhry, Shail Jain, *"Linear Integrated Circuits",* New Age International Pvt. Ltd., 2000.
	Reference Books/Other Reading Material
3.	Ronald. K. Jurgan *"Automotive Electronics Handbook"*, 2nd Edition , McGraw-Hill, Inc.
4.	Sergio Franco, *"Design with Operational Amplifiers and Analog Integrated Circuits"*, 3rd Edition, Tata Mc Graw-Hill, 2007.
5.	Robert F. Coughlin, Frederick F. Driscoll, *"Operational Amplifiers and Linear Integrated Circuits",* 6th Edition, PHI, 2001.

Course Nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE203L	**Automotive Components And Assembly Drawing**			**L**	**T**	**P**	**C**
				0	**1**	**3**	**2**
Co-requisite:	NIL						
Prerequisite:	15ME105L						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire ability in designing and making the assembly of various automobile components					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand orthographic projections and drawing standards	a	b			k
2.	Draw different automotive joints	a	b			k
3.	Understand representations of the various mechanical components	a				k
4.	Understand geometric, dimensioning and tolerances	a		d	g	

Session	Class lecture/ Practice	Title/Details of Chapter	Contact hours	C,D,I,O	IOs	References
1	Class lecture	Introduction and Orthographic Projection	1	C	1	1
2	Practice	**Orthographic Projection**	2	C, D	1	1
3	Class lecture	BIS Code of practice for Engineering Drawing: General principles of presentation, conventional representation of dimensioning (7 Types) and sectioning, threaded parts, gears, springs and common features.	1	C	1	1
4	Practice	**Conventional Representation of Engineering Parts and Dimensioning**	2	C,D	3	2
5	Class lecture	Abbreviations and symbols used in technical drawings. Symbols and method of indication on the drawing for surface finish, welding and riveted joints.	1	C	2	1
6	Practice	**Assembly Drawing of Sleeve and Cotter Joints and Flange Coupling**	2	C,D	2	2
7	Class lecture	Limit system	1	C	2	1
8	Practice	**Assembly Drawing of Plummer Block**	2	C,D	3	2
9	Class lecture	System of Fits -Basic hole systems	1	C	1	2
10	Practice	**Assembly Drawing of Clutches (Single and Multiple)**	2	C,D	5	2
11	Class lecture	System of Fits - Basic shaft systems	1	C	1	1
12	Practice	**Assembly Drawing of Piston and Petrol Engine Connecting Rod**	2	C,D	5	2
13	Class lecture	Geometric dimensioning and tolerance. Principles, types and application of fuel pumps in automobile engineering.	1	C	4	3
14	Practice	**Assembly Drawing of Fuel Pump**	2	C,D	5	2
15	Class lecture	Study of Nozzles, types, nozzle pin, nozzle holder, screw adjuster	1	C	5	1
16	Practice	**Assembly Drawing of Fuel Injector**	2	C,D	5	3
17	Class lecture	Study of positive displacement type pumps, mounting bracket, pump body and bushings, shafts with gear	1	C	5	2
18	Practice	**Assembly Drawing of Rotary Gear Pump**	2	C,D	5	1
19	Class lecture	Study of shell, insulator, central Electrode and Sealing Gasket	1	C	5	1
20	Practice	**Assembly Drawing of Sparkplug**	2	C,D	5	4
	Total Contact Hours		**30**			

Learning Resources	
Sl. No.	**Text Books**
1.	Narayana.K.L, Kanniah.P and Venkata Reddy.K, *"Machine Drawing"*, New Age International, New Delhi, 2006
2.	Gopalakrishnan.K.R, *"Machine Drawing"*, Subash Publishers, Bangalore, 2000.
	Reference Books/Other Reading Material
3.	Sidheswar Kannaiah.N, Sastry.P.V.V.V, *"Machine Drawing"*, Tata McGraw Hill, New Delhi, 1997.
4.	Bhatt.N.D, *"Machine Drawing"*, Charotar publishing house, Anand, 1999.
5.	Junnarkar.N.D, *"Machine Drawing",* First Indian print, Pearson Education (Singapore) Pvt. Ltd., 2005.
6.	"*Design Data: Data Book of Engineers"*, PSG College of Technology, Kalaikathir Achchagam
7.	Revised IS Codes: 10711, 10712, 10713, 10714, 9609, 11665, 10715, 10716, 11663, 11668, 10968, 11669, and 8000.

Course nature				Practical		
Assessment Method – Practical Component (Weightage 50%)						
In-semester	**Assessment tool**	**Experiments**	**Record**	**MCQ/Quiz/Viva Voce**	**Model examination**	**Total 50%**
	Weightage	**40%**	**5%**	**5%**	**10%**	
End semester examination Weightage:						**50%**

Semester IV

15AE204	Applied Thermal Engineering For Automotive Engineers			L	T	P	C
				2	2	0	3
Co-requisite:	NIL						
Prerequisite:	**15ME201**						
Data Book / Codes/Standards	Approved Heat and Mass Transfer data book, Psychometric chart and Refrigerant table						
Course Category	P	Professional Core	Engine				
Course designed by	Department of Automobile engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	The students are expected to understand the concept and working of gas power cycles, engine performance, heat transfer, air compressors, refrigeration and air conditioning systems.

Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand various gas power cycles	a	c	e	
2.	Integrate the basic concepts into various thermal applications like testing of engine performance, air compressor, refrigeration and air conditioning.	a	c	e	f
3.	Enlighten the various mode of heat transfer and their engineering application	a	e		

Session	Description of Topic	Contact hours	C,D,I,O	IOs	Reference
1.	**Unit I: Gas Power Cycles**	**9**			
2.	Introduction, Air standard cycles, Assumptions	1	C	1	1,2
3.	Otto Cycle, PV,TS Diagram, Efficiency, MEP, Numerical	2	C,D	1	1,2
4.	Diesel Cycle, PV,TS Diagram, Efficiency, MEP, Numerical	3	C,D	1	1,2
5.	Dual Cycle, PV,TS Diagram, Efficiency, MEP, Numerical	3	C,D	1	1,2
	Unit II: Engine Performance	**8**			
6.	Performance parameters, BP, FP, IP, Torque specific fuel consumption, Specific Energy consumption, volumetric efficiency, thermal efficiency, mechanical efficiency, Engine specific weight, and heat balance	2	C	2	1,2,3
7.	Measurement of different engine Performance Parameters	1	C	2	1,2,3
8.	Measurement of FP, Different Methods	1	C	2	1,2,3
9.	Numerical related to BP	1	D	2	1,2,3
10.	Numerical related to Morse Test	2	D	2	1,2,3
11.	Numerical related to heat balance	1	D	2	1,2,3
	Unit III: Heat Transfer	**8**			
12.	**Conduction**: One-dimensional Heat Conduction Plane wall, Cylinder, Composite walls, Critical thickness of insulation, Heat transfer through extended surfaces (simple fins)	3	C,D	3	4,5
13.	**Convection:** Free convection and forced convection - Internal and external flow.	3	C,D	3	4,5
14.	**Heat Exchangers**: Types of heat Exchangers - LMTD method and NTU - Effectiveness - Overall Heat Transfer Coefficient - Fouling Factors.	2	C,D	3	4,5
	Unit IV: Reciprocating Aircompressors & Refrigeration System	**8**			
15.	Introduction of Air Compressor, Types, Construction and Working of Single acting and double acting air compressors	1	C	2	1,2
16.	Basics of Intercooler, Construction, Working - Multi stage Air Compressor	1	C	2	1,2
17.	Compressor - work required, effect of clearance volume, volumetric efficiency-Problems	1	C,D	2	1,2
18.	Fundamentals of refrigeration, COP, reversed Carnot cycle	1	C	2	1,2
19.	Simple vapour compression refrigeration system	1	C	2	1,2
20.	Analysis of Vapour Compression Refrigeration Cycles - Problems	1	C,D	2	1,2
21.	Simple vapour absorption refrigeration system	1	C	2	1,2

22.	Desirable properties of an ideal refrigerant, Different Types of Refrigerants	1	C	2	1,2
	Unit V: Psychrometry And Air Conditioning	**8**			
23.	Properties of atmospheric air	1	C	2	1,2
24.	Psychrometric chart, relations	1	C	2	1,2
25.	Psychrometric Processes, Sensible heating and cooling, Humidification, Dehumidification, BPF for heating and cooling coils	1	C	2	1,2
26.	Cooling and dehumidification, heating and Humidification	1	C	2	1,2
27.	Summer and Winter Air conditioning system for Various Climatic Conditions	1	C	2	1,2
28.	Air conditioning - year round air conditioning system	1	C	2	1,2
29.	Introduction to Cooling load calculations	1	D	2	1,2
30.	Study of Automotive air conditioning systems	1	C	2	1,2
31.	Cycle test-I	1			
32.	Cycle test-II	2			
33.	Surprise test	1			
	Total Contact Hours	**45**			

Learning Resources	
Sl. No.	**Text Book**
1	Kothandaraman.C.P, Domkundwar.S, Anand Domkundwar, *"A Course in Thermal Engineering",* Dhanpat Rai & Co. (P) Ltd., 2010.
	Reference Books
2	RajputR.K, *"Thermal Engineering"*, Laxmi Publications, 8th Edition, New Delhi, 2010.
3	Rajput R. K, *"A textbook of Internal Combustion Engines"*, 2nd Edition, Laxmi Publications (P) Ltd, 2007.
4	Dr. R. C. Sachdeva, *"Fundamentals of Engineering Heat and Mass Transfer"*, New Age Science Ltd., New Delhi, 2009
5	Kothandaraman.C.P, Subramanyan.S, *"Heat and Mass Transfer Data Book"*, New age International, 7th Edition, 2010.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE375L	**Minor Project-I**			**L**	**T**	**P**	**C**
				0	**0**	**3**	**2**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional					
Course designed by	Department Of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To obtain a hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.

Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able								
1.	To conceptualise a novel idea / technique into a product	c						
2.	To think in terms of multi-disciplinary environment		d					
3.	To understand the management techniques of implementing a project				k			
4.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.			g				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	An Multidisciplinary project to be taken up by a team of maximum of ten students. Development of prototype product, a 3D model, simulation, blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate.		C,D,I	1,2, 3,4	
	Total Contact Hours				

Course Nature		**Project – 100% internal continuous assessment**	
Assessment Method (Weightage 100%)			
In-semester	**Assessment tool**	Refer the table	**Total**
	Weightage	Refer the table below	**100%**
		End semester examination Weightage :	**0%**

Assessment component	Expected outcome	Evaluators	Criteria or basis	Marks
Project proposal (Review – I)	A short presentation to be delivered on: • A brief, descriptive project title (2-4 words). This is critical! • The 3 nearest competitors (existing solutions) and price. • Team members name, phone number, email, department/degree program, and year. • A description of the product opportunity that has been identified. To include: Documentation of the market need, shortcomings of existing competitive products, and definition of the target market and its size. • Proposed supervisor / guide	Panel of reviewers	Viability / feasibility of the project Extent of preliminary work done.	**0**
Review II	• Mission Statement / Techniques • Concept Sketches, Design Specifications / Modules & Techniques along with System architecture • Coding	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**20**
Review III	• Final Concept and Model / Algorithm/ Technique • Drawings, Plans / programme output • Financial Model / costing • Prototype / Coding • Final Presentation and Demonstration	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**50**
Final technical Report	A good technical report	Supervisor / Guide	Regularity, systematic progress, extent of work and quality of work	**30**
			Total	**100**

Assessment components

15AE380L	Seminar-I	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P	Professional Core			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To enhance the disseminating skills of the student about the current and contemporary research work that is being carried out across the world.

Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able								
1.	To understand the research methodology adopted by various researchers	h	i	j				
2.	To mathematically model a problem, critically analyse it and adopt strategies to solve	b	c	e				
3.	To understand and present a well-documented research	e	g					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Guidelines for conducting 15xx390L Seminar for B.Tech 1. Upon registering for the course the student must identify a sub-domain of the degree specialization that is of interest to the student and start collecting research papers as many as possible. 2. After collecting sufficient number of research papers the student must peruse all the papers, meet the course faculty and discuss on the salient aspects of each and every paper. 3. The course faculty, after discussion with the student will approve TWO research papers that is appropriate for presentation. 4. The student must collect additional relevant reference materials to supplement and compliment the two research papers and start preparing the presentation. 5. Each student must present a 15-minute presentation on each of the approved research paper to the panel of evaluators. 6. The presenter must present one research paper within the first half of the semester (6 weeks) and another research paper in the next half of the semester (6 weeks) as per the schedule. 7. All other students registered for the course will form the audience. 8. The audience as well as the evaluators will probe the student with appropriate questions and solicit response from the presenter.		C,D	1,2,3,4	
	Total Contact Hours	**30**			

Course nature		**100% internal continuous assessment.**		
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Presentation 1	Presentation 2	**Total**
	Weightage	**50%**	**50%**	**100%**
End semester examination Weightage :				**0%**

15AE385L	Massive Open Online Courses (MOOCs)-I	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Core				
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To offer students the opportunity to study with the world's best universities by integrating select MOOCs in a regular degree programme and providing students full credit transfer, as per university regulations, if they earn a "Verified / Completion Certificate" and take a proctored examination through a secure, physical testing center.

Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able								
1.	To apply the concepts, theories, laws, technologies learnt herein to provide engineering solutions.	f	h	i	j			

Course nature		**Online - 100% internal continuous assessment.**				
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Quiz	Assignment	Non-proctored / Unsupervised Tests	Proctored / Supervised Test	**Total**
	Weightage	**25%**	**25%**	**10%**	**40%**	**100%**
					End semester examination Weightage :	**0%**

Registration process, Assessment and Credit Transfer:

1. Students can register for courses offered by approved global MOOCs platforms like edX, Coursera or Universities with which SRM partners specifically for MOOCs.
2. Annually, each department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be recognised and accepted for credit transfer.
3. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring the tests, uploading the marks / grades, and collecting and submitting the graded certificate(s) to the CoE, within the stipulated timeframe.
4. Student who desires to pursue a course, from the above department-approved list, through MOOCs must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.
5. The maximum credit limits for course registration at SRM will include the MOOCs course registered.
6. The student must periodically submit the marks / grades obtained in various quizzes, assignments, tests etc immediately to the Faculty Advisor or the Course Coordinator for uploading in the university's academic module.
7. The student must take the final test as a Proctored / Supervised test in the university campus.
8. The student must submit the "Certificate of Completion" as well as the final overall Marks and / or Grade within the stipulated time for effecting the grade conversion and credit transfer, as per the regulations. It is solely the responsibility of the individual student to fulfil the above conditions to earn the credits.
9. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100% , if the credits are transferred, after satisfying the above (1) to (7) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.

15AE490L	Industrial Module-I	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Core				
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To impart an insight into the current industrial trends and practices

Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able								
1.	To obtain an insight into the current industrial trends and practices							
2.	To obtain an insight into the technologies adopted by industries							
3.	To obtain an insight into the technical problems encountered by the industries and the scope for providing solutions.							
4.	To network with industry							

Description of Topic	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1. He department will identify and shortlist few emerging topics that are trending in industry. 2. The department will identify experts from industry who are willing to deliver modules on the shortlisted topics. 3. The identified expert will assist the department in formulating the course content to be delivered as a 30-hour module, prepare lectures notes, ppt, handouts and other learning materials. 4. The department will arrange to get the necessary approvals for offering the course, from the university's statutory academic bodies well before the actual offering. 5. The department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be offered as industry module. 6. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring/supervising/assessment the quizzes, assignments, tests etc, uploading the marks, attendance etc, within the stipulated timeframe. 7. The Student who desires to pursue a course, from the above department-approved list, must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University. 8. The maximum credit limits for course registration at SRM will include the Industry Module also. 9. All academic requirements of a professional course like minimum attendance, assessment methods, discipline etc will be applicable for this Industry Module. 10. The course will be conducted on weekends or beyond the college regular working hours.		C,D,I,O	1,2,3,4	
Total Contact Hours	**30**			

Course nature		**100% internal continuous assessment.**					
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage							**50%**

Semester V

15AE301	Design of Automotive Components	L	T	P	C
		2	2	0	3
Co-requisite:	NIL				
Prerequisite:	**15ME203**				
Data Book / Codes/Standards	Approved Design Data book				
Course Category	P Professional Core	Design Engineering			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To acquire knowledge about the designing of automotive engine components				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Design of shaft	a	e		
2.	Design of cylinder and piston	a	e		
3.	Design of connecting rod	a	e		
4.	Familiarize with design procedure of crank shaft	a	e		
5.	Design of cylinder head and valve actuating mechanism	a	e		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Design Of Shaft	9			
1	Materials used for shaft, manufacturing of shaft and types of shaft	1	C	1	1,2
2	Standard size of transmission shafts, stresses in shafts	1	C,D	1	1,2
3	Maximum permissible working stresses for transmission for transmission shafts	1	C,D	1	1,2
4	Design of shaft- shaft subjected to twisting moment only, shaft subjected to bending moment, shaft subjected to combined twisting moment and bending moment	3	C,D	1	1,2
5	Design of shaft subjected to fluctuating load, axial load in addition to combined torsion and bending loads	2	C,D	1	1,2
6	Design of shaft on the basis of rigidity	1	C,D	1	1,2
	Unit II: Design of Cylinder And Piston	**8**			
7	Introduction to I.C engines and components	1	C	2	1,2
8	Materials selection based on engine components and its function-Design of cylinder block and cylinder.	3	C,D	2	1,2
9	Description on function of piston in an I.C engines-Design of piston	2	C,D	2	1,2
10	Description on piston rings-compression ring-oil rings, piston failure	2	C,D	2	1,2
	Unit III: Design of Connecting Rod	**8**			
11	Introduction - material selection for connecting rod	1	C	3	1,2
12	Design of connecting rod small end	2	C,D	3	1,2
13	Design of connecting rod big end and shank design	2	C,D	3	1,2
14	Design of connecting rod-cap bolt design	3	C,D	3	1,2
	Unit IV: Design of Crankshaft	**8**			
15	Introduction about crank shaft and its function in an I.C Engine.	1	C	4	1,2
16	Materials selection for crankshaft	1	C	4	1,2
17	Balancing of I.C. engines, MI of Crankshaft, significance of firing order.	2	C,D	4	1,2
18	Design of crankshaft under bending and twisting, balancing weight calculations.	2	C,D	4	1,2
19	Development of short and long crank arms. Front and rear end Details. Matrix from element stiffness	2	C,D	4	1,2

	Unit V: Design of Cylinder Head and Valve Actuating Mechanisms	**8**			
20	Introduction about cylinder block and head in an I.C Engine	1	C,D	5	1,2
21	Design of cylinder block head, bolt loads and gasket	2	C,D	5	1,2
22	Design of valve spring and valves	3	C,D	5	1,2
23	Design of push rod	2	C,D	5	1,2
24	Cycle test-I	1			
25	Cycle test-II	2			
26	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Kulkarni S. G, *"Machine Design",* Tata McGraw-Hill Education, 2008.
2.	Bhandari V, *"Design of Machine Elements",*Tata McGraw-Hill Education, 2010.
	Reference Books/Other Reading Material
3.	William Orthein, *"Machine Component Design"*, Jaico Publishing House, 1998 - 99.
4.	Shigley J, *"Mechanical Engineering Design"*, Mc Graw Hill, 2001.
5.	Joseph Edward Shigley and Charles R.Mischke, *"Mechanical Engineering Design"*,McGraw-Hill International Edition, 1989.
6.	Gitin M.Maitra and LN Prasad, "*Hand Book of Mechanical Design"*, Tata McGraw Hill, 1985.
7.	Spots M. F, "*Design of Machine Elements"*, Prentice Hall of India Private Ltd., New Delhi, 1983.
8.	William Orthwein, "*Machine Component Design"*, Vol. I and II, Jaico Publising house, Chennai, 1996
9.	*Design Data*, PSG College of Technology, 2008.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE302	**Automotive Chassis**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Core	Vehicle Technology			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To familiarize the students with the fundamentals of Automotive Chassis.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand the basic knowledge about various vehicle frames, front axles and steering systems.	a	j		
2.	Understand the construction and working principle of final drives.	a	j		
3.	Gain knowledge about rear axle and suspension system.	a	j		
4.	Understand the conditions for true rolling motion of wheels during steering.	a	j		
5.	Gain knowledge about the constructional feature of wheels and tyres	a	j		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Frames, Front Axle and Steering System	**8**			
1.	Frames – Types, Materials, Load acting on frames	1	C	1	2
2.	Front axle – Types, Construction	1	C	2	2
3.	Front wheel geometry - Castor, Camber, King pin inclination, Toe-in, Toe-out– Effects	1	C,D	3	2
4.	Conditions for true rolling motion of wheels during steering	1	C,D	4	1,2
5.	Ackerman and Davis steering system.	1	C,D	2	1,2
6.	Constructional details of steering linkages	1	C	2	1,2
7.	Different types of steering gear boxes	1	C	2	1,2
8.	Power assisted steering	1	C	2	1,2
	Unit II: Drive Line and Final Drive	**8**			
9. .	Effect of driving thrust and torque reactions	1	C	2	2
10.	Hotchkiss drive, torque tube drive, pan -hard rods, radius rods	1	C	2	2
11.	Propeller shaft, Universal joints, Constant velocity universal Joints.	1	C	2	2
12.	Different types of final drive, Worm and worm wheel, Straight bevel gear, Spiral bevel gear and hypoid gear final drives	1	C	2	2
13.	Double reduction final drives	1	C	2	2
14.	Twin speed final drives	1	C	2	2
15.	Differential principle, Non-slip differential	1	C	2	2
16.	Differential locks. Differential housing	1	C	2	2
	Unit III –Rear Axles and Suspension System	**8**			
17.	Types of loads acting on rear axles. Rear axles construction	1	C	2	2
18.	Full floating, Three quarter floating and semi floating rear axles.	2	C	2	2
19.	Rear axle housing, Construction details of multi drive axle vehicles.	1	C	2	2
20.	Suspension system – needs, types, Independent suspension	1	C	2	1,2
21.	Rubber suspension, Pneumatic suspension, Shock absorbers.	3	C	2	1,2
	Unit IV: Braking System	**8**			
22.	Theory of braking, Classification of brakes	1	C	2	1,2
23.	Drum brake & disc brakes, Constructional details- Mechanical brakes	1	C	2	1,2
24.	Constructional details- Pneumatic brakes	1	C	2	1,2
25.	Constructional details- hydraulic brake, Servo brake	2	C	2	1,2
26.	Types of retarders like eddy current and hydraulic retarder	1	C	2	1,2
27.	Antilock braking systems	1	C	2	1,2
28.	Regenerative braking system	1	C	2	1,2
	Unit V : Wheels and Tyres	**9**			
29.	Types of wheels, wheel dimensions	1	C	2	2,4
30.	Disc wheel – construction, Inset, zero-set, outset wheels	1	C	2	2,4
31.	Reversible, Divided, Flat base wheel rim	1	C	2	2,4
32.	Wire wheel - construction	1	C	2	2,4
33.	Alloy wheel construction	1	C	2	2,4
34.	Tyre- types, properties, materials, tyre designation	1	C	2	2,4
35.	Conventional tube tyres - construction	1	C	2	2,4
36.	Tubeless tyres - construction	1	C	2	2,4
37.	Cross ply, Radial ply tyres.	1	C	2	2,4
38.	Cycle test-I	1			
39.	Cycle test-II	2			
40.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Tim Gilles, "*Automotive Chassis-Brakes, Steering and Suspension*", Thomson Delmer Learning, 2005.
2.	Heldt.P.M, "*Automotive Chassis*", Chilton Co., New York,1990.
	Reference Books/Other Reading Material
3.	Jornsen Reimpell, Helmut Stoll, "*Automotive Chassis: Engineering Principles*", Elsevier, 2nd edition, 2001.
4.	Giles.J.G, "*Steering Suspension and tyres*", Iliffe Book Co.,London,1988

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE303	**Automotive Engines**			**L**	**T**	**P**	**C**
				3	**0**	**0**	3
Co-requisite:	NIL						
Prerequisite:	15AE204						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional-Core	Engine				
Course designed by	Department of Automobile engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	On completion of this course, the students are expected to understand the concept of working principles of SI and CI Engines, lubrication, cooling system, super charging and scavenging systems.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand various components of the engine and its functions.	a	c		
2.	Understand the combustion in SI Engine	a	c		
3.	Gain knowledge on combustion in CI Engine	a	c	e	
4.	Understand the lubrication and cooling system in IC Engines.	a	c	e	f
5.	Understand the turbo, supercharging and scavenging system in I C Engines	a	c	f	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Engine Components	**7**			
1.	Constructional details of engine components, function, materials,	2	C	1	1,2
2	Valve timing diagram for SI and CI engines, Port timing diagram- Firing order and its significance	1	C	1	1,2
3	Intake system components - Discharge coefficient, Pressure drop	1	C	1	1,2
4	Air filter, intake manifold, Connecting Pipe	1	C	1	1,2
5	Exhaust system components – Exhaust manifold and exhaust pipe	1	C	1	1,2
6	Spark arresters - Exhaust mufflers, Types, operation	1	C	1	1,2
	Unit II: Combustion in SI Engines	**10**			
7	Combustion process in IC engines, Stages of combustion, Flame propagation	2	C	1,2	1,2
8	Flame velocity and area of flame front - Rate of pressure rise - Cycle to cycle variation	1	C	1,2	1,2
9	Abnormal combustion - Theories of detonation	1	C	1,2	1,2
10	Effect of engine operating variables on combustion	1	C	1,2	1,2
11	Combustion chambers -types, factors controlling combustion chamber design	2	C,D	1,2	1,2
12	Gasoline injection system	3	C	1,2	1,2

	Unit III: Combustion in CI Engines	**10**			
13	Importance of air motion - Swirl, squish and turbulence - Swirl ratio. Fuel air mixing	2	C	1,3	1,2
14	Stages of combustion	1	C	1,3	1,2
15	Delay period - Factors affecting delay period	1	C	1,3	1,2
16	Knocking in CI engines - methods of controlling diesel knock.	1	C	1,3	1,2
17	CI engine combustion chambers, Combustion chamber design objectives - open and divided. Induction swirl, turbulent combustion chambers	1	C	1,3	1,2
18	Air cell chamber - M Combustion chamber	1	C	1,3	1,2
19	Diesel injection system	3	C	1,3	1,2
	Unit IV: Lubrication and Cooling	**7**			
20	Need for cooling system - Types of cooling system - Liquid cooled system	1	C	1,4	1,2
21	Thermosyphon system, Forced circulation system, pressure cooling system	2	C	1,4	1,2
22	Properties of coolant, additives for coolants	1	C	1,4	1,2
23	Need for lubrication system	1	C	1,4	1,2
24	Mist lubrication system, wet sump any dry sump lubrication	1	C	1,4	1,2
25	Properties of lubricants, consumption of oil	1	C	1,4	1,2
	Unit V: Supercharging and Scavenging	**7**			
22	Objectives - Effects on engine performance - engine modification required	1	C	1,5	1,2
24	Thermodynamics of supercharging and Turbocharging –	1	C	1,5	1,2
25	Turbo lag-Windage, losses	1	C	1,5	1,2
26	Turbo charging methods - Engine exhaust manifold arrangements.	1	C	1,5	1,2
27	Classification of scavenging systems -Mixture control through Reed valve	1	C	1,5	1,2
28	Induction - Charging Processes in two-stroke cycle engine - Terminologies	1	C	1,5	1,2
29	Shankey diagram - perfect displacement, perfect mixing.	1	C	1,5	1,2
30	Cycle test-I	1			
31	Cycle test-II	2			
32	Surprise tset	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1	Ganesan V, "*Internal combustion engines*", 4th edition, Tata McGraw Hill Education, 2012.
2	Rajput R. K, "*A textbook of Internal Combustion Engines*", 2nd edition, Laxmi Publications (P) Ltd, 2007.
	Reference Books
3	John. B, Heywood, "*Internal Combustion Engine Fundamentals*", McGraw Hill Publishing Co., New York, 1900 .
4	Ramalingam K. K, "*Internal Combustion Engines*", Second Edition, Scitech Publications,2009
5	Mathur and Sharma, "*A course on Internal combustion Engines*", Dhanpat Rai & Sons, 1985.
6	Edward F, Obert, *"Internal Combustion Engines and Air Pollution"*, Intext Education Publishers, 1980.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE304L	Engine and Fuel Testing Laboratory			L	T	P	C
				0	0	2	1
Co-requisite:	15AE303						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Engine				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	This Laboratory course is intended to give the students, experimental knowledge on the performance and operations of I.C. Engines				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Obtain the knowledge of test engines	a	b		
2.	Test the lubricants and fuels used for IC engines	a	b		
3.	Conduct the performance and heat balance test on IC engines using various dynamometers.	a	b		
4.	Conduct the test of fuels	a	b		

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Valve Timing Diagram for Four Stroke Engine Valve Timing Diagram for Two Stroke Engine	3	C,I	1	1
2.	Performance test on constant speed diesel engine	3	I,O	1	1
3.	Performance test on Petrol engine at full throttle and part throttle conditions	3	I,O	1	1
4.	Performance test on Diesel Engine at full load and part load conditions	3	I,O	1	1
5.	Morse test on petrol engines	3	I,O	1,2	1
6.	Test for optimum coolant flow rate in IC engines	3	I,O	1,2	1
7.	Energy Balance test on an Automotive Diesel Engine	3	I,O		1
8.	Determination of flash and fire point of fuels and lubricating oil by different methods	3	I,O	2,4	1
9.	Determination of viscosity of oil by different methods like, Redwood, Say bolt and Engler's Viscometer	3	I,O	2,4	1
10.	Study and use of pressure pickup, charge amplifier, storage oscilloscope and signal analyzers used for IC Engine Testing	3	C,I	2,3	1
	Total contact hours	**30**			

Learning Resources						
Sl. No.	**References**					
1.	*Laboratory Manual*					
Course nature			**Practical**			
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination	**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**	**60%**
					End semester examination Weightage :	**40%**

15AE305L	Automotive Components Laboratory			L	T	P	C
				0	0	2	1
Co-requisite:	15AE302						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	This Laboratory course is intended to give the students, experimental knowledge about various automotive components.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand different types of frames used in various Automobiles	b			
2.	Dismantle and assemble the various systems in automobile	b			
3.	Understand the Seating Layout	b			

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Study of Frames used for HMV, Car, Two and Three Wheelers	3	C,I	1,2	1
2.	Dismantling and assembling of different types of engines	3	I,O	1,2	1
3.	Dismantling and assembling of Fuel supply system	3	I,O	1,2	1
4.	Dismantling and assembling of Steering system	3	I,O	1,2	1
5.	Dismantling and assembling of Suspension system	3	I,O	1,2	1
6.	Dismantling and assembling of Braking system	3	I,O	1,2	1
7.	Dismantling and assembling of Wheels and Tyres	3	I,O	1,2	1
8.	Dismantling and assembling of Propeller Shaft, Universal Joints and Differential	3	I,O	1,2	1
9.	Study of Driver Seat	3	C,I	1,2	1
10.	Brake adjustment and bleeding	3	I,O	1,2	1
	Total contact hours	**30**			

Learning Resources	
Sl. No.	**References**
1.	*Laboratory Manual*

Course nature				**Practical**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination	**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**	**60%**
					End semester examination Weightage :	**40%**

15AE390L	Industrial Training-I			L	T	P	C
				0	0	2	1
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	PROFESSIONAL CORE					
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To provide short-term work experience in an Industry/ Company/ Organisation						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able							
1.	To get an inside view of an industry and organization/company				j		
2.	To gain valuable skills and knowledge				j		
3.	To make professional connections and enhance networking	f	g				
4.	To get experience in a field to allow the student to make a career transition			i			

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	1. It is mandatory for every student to undergo this course. 2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation. 3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme. 4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organisation as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department. 5. The committee will then assess the student based on the report submitted and the presentation made. 6. Marks will be awarded out of maximum 100. 7. Appropriate grades will be assigned as per the regulations. 8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations. 9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits. 10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO. 11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the		D, I,O	1,2,3,4	
	Total contact hours				

Course nature				**Training – 100% internal continuous assessment**
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	**Presentation**	**Report**	**Total**
	Weightage	**80%**	**20%**	**100%**
End semester examination Weightage :				**0%**

Semester VI

15AE308J	CAD Analysis for Automotive Engineers			L	T	P	C
				3	0	2	4
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Design Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To enrich the student with the knowledge of software tools and their applications in mechanical engineering design and analysis.

Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand concepts of modeling in 2D and 3D	a					
2.	Gain knowledge on computer graphics		b				
3.	Understand CAD Packages and recent technologies						k
4.	Gain knowledge about FEM		b	c	e	j	k
5.	Understand the modeling and analysis tools	a		c	e		k

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction	**8**			
1.	Introduction to Design process – CAD	1	C	1	1,2,3
2.	Geometric Modeling: Types - Wireframe, surface and solid modeling	1	C	1	1,2,6
3.	Solid modeling techniques: CSG and B-rep	2	C	1	1,2,4
4.	Operations: Boolean, Extrude, Sweep, Revolve	2	C	1	1,2,4
5.	Entities - Line - Circle - Ellipse - Parabola	2	C,D	1	1,2,4
	Unit II: Graphics Concepts (2D and 3D)	**8**			
6.	Coordinate systems	1	C	2	1,2,4
7.	Transformations: translation, scaling, reflection, rotation	1	C	2	1,2,4
8.	Concatenated transformation - Inverse transformation	**2**	C	2	1,2,4
9.	Hidden line removal - Shading - Colouring	2	C	2	1,2,4
10.	Rendering - Animation (Basic treatment only).	2	C	2	1,2,4
	Unit III: Software Packages and Recent Technology	**8**			
11.	Commercial solid modeling packages	1	C,D	3	1,2,4
12.	Salient features - Technical comparison - Modules and tools	1	C,D	3	1,2,4,
13.	Brief outline of data exchange standards	**1**	C	3	1,2,4
14.	Brief outline of feature technology	2	C	3	1,2,4
15.	Classification of features - Design by features	2	C	3	1,2,4
16.	Applications of features - Advantages and limitations.	1	C	3	1,2,4
	Unit IV: FEM Fundamentals	**8**			
17.	Introduction - Steps involved in FEA	1	C,D	5	1,5
18.	Nodes - Elements and their types, shape function, constraints, forces and nodal displacements	2	C,D	5	1,5
19.	Stiffness matrix - Solution techniques	2	C,D	5	1,5
20.	Analysis of spring element.	1	C,D	5	1,5
21.	Simple problems involving stepped bar subject to axial loading and simple structural members with triangular element.	2	C,D	5	1,5
	Unit V:Analysis	**9**			
22.	FEA in CAD Environment: Stages of FEA in CAD environment	2	C,I	4	1,5
23.	Preprocessor, Solver and postprocessor	2	C,D	4	1,5
24.	Demonstration of the above using any one commercial packages	2	C,D	4	1,5

25.	Brief outline of kinematic analysis	1	I,D	4	1,5
26.	Manufacturability analysis and simulation	2	I,D	4	1,5
27.	Cycle test-I	1			
28.	Cycle test-II	2			
29.	Surprise test	1			
	Total contact hours	**45**			

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1	Limits, Commands, tool bars and Dimensioning	3	C	1	7
2	Orthographic projections – I (from part model)	3	C, I, O	1	7
3	Orthographic projections – II (from assembly model)	3	C, I, O	1	7
4	3D part modeling with basic features.	3	I, O	3	7
5	3D part modeling with advanced features.	3	I, O	3	7
6	3D assembly modeling	3	I,O	2	7
7	Data exchange standards.	3	I, O	5	7
8	3D to 2D conversion.	3	I, O	2	7
9	Structural Analysis	3	I, O	4	7
10	Thermal Analysis	3	I, O	4	7
	Total contact hours	**30**			

Learning Resources	
Sl. No.	**Text Books**
1.	Ibrahim Zeid, "*CAD / CAM - Theory and Practice"*., Tata Mcgraw-Hill, New Delhi, 2001
2.	Radhakrishnan. P "*CAD / CAM / CIM "* New age international, 2000
3.	Chairs Mcmahon and Jimmie Browne, "*CAD / CAM*"*.*,AddisionWesly, New York, 2000
	Reference Books/Other Reading Material
4.	Newman and Sproull R. F., "*Principles of interactive computer graphics"*, Tata Mcgraw-Hill, New Delhi,1997
5.	Chandupatla and Belagundu, "*Introduction to Finite Element Methods in Engineering"*, Prentice Hall of India Private Limited, New Delhi, 1997
6.	Mikell P. Groover, "*CAD / CAM*"., Prentice Hall of India Private Limited, New Delhi, 1997
7.	*Laboratory Manual.*

Course nature				**Theory + Practical**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
						End semester examination Weightage :	**40%**

15AE307J	**Automotive Electrical and Electronics System**			**L**	**T**	**P**	**C**
				3	**0**	**2**	**4**
Co-requisite:	NIL						
Prerequisite:	15AE202						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Vehicular Electronics And Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To provide the knowledge about the application of electrical and electronics in automotive systems						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understanding battery, Cranking motor construction and testing methods.	a	b			e	f
2.	Understand the principle of alternator and to test the alternator	a	b			e	
3.	Understand the Electronic Controls in Gasoline Engine	a	b		d		
4.	Understand the basics of Vehicle Motion Control and telematics system	a	b		d	e	
5.	Perform OBD II test on vehicle and Perform rapid control prototyping with real-time hardware	a	b	c	d	e	

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Batteries and Starting Systems	**8**			
1.	Vehicle Batteries –Lead acid battery Construction, Working Principle, Battery Rating	1	C	1	1
2.	Lead Acid battery Charging methods and Testing Methods and Fault Diagnosis.	1	C,D	1	1
3.	Requirement of a starting System, Starter motor Construction and Working.	2	C,D	1	1
4.	Starter Drive Mechanism –Bendix drive and Folo-thru drive	1	C	1	1
5.	Starter Drive Mechanism – Over Running Clutch and Solenoid Mechanism. Starter Motor Fault Diagnosis	1	C	1	1
6.	New Developments in Battery Technologies and Starting System	2	C	1	1
	Unit II:Charging System and Lighting Auxiliaries	**8**			
7.	Alternator Principle, Construction, Working and its merits over D.C Generator.	1	C,D	2	1
8.	Alternator Charging Circuits and Rectification of AC to DC, Alternator Testing Methods	1	C,D	2	1
9.	Mechanical and Electronic Voltage regulator –Principle and Working	1	C,D	2	1
10.	Lighting Fundamentals and Lighting Circuit	2	C	2	1
11.	Conventional Headlamps and LED Lighting System	2	C	2	1
12.	Wiper system and Signaling and Warning system	1	C	2	1
	Unit III:Electronic Engine Management System	**8**			
13.	Gasoline Engine Fuel Injectors-Single point, Multi Point Fuel Injections, Testing of Fuel Injectors.	1	C,D	3	2,4
14.	Conventional Ignition System -Electronic Ignition System – Programmed ignition system, Distributor less Ignition System	2	C	3	1,2
15.	Digital Engine Control Modes	1	C	3	2
16.	EGR Control and variable valve timing	2	C	3	2
18.	Ignition Controlling –Closed loop ignition timing, Spark Advance Correction Scheme	**2**	C	3	2
	Unit IV: Fundamentals of Vehicle Motion Control	**8**			
19.	Cruise Control System and Adaptive Cruise Control System Working –Throttle Actuator Stepper Motor Based Control	1	C,D	4	2
20.	Antilock Braking Mechanism –Tire Slip Controller	2	C,D	4	2
21.	Electronic Suspension System –Variable Damping, Variable Spring rate	3	C,D	4	2
22.	Electric Power Assisted Steering Mechanism, Four Wheel Steering and Steer-by-Wire	2	C,D	4	2
	Unit V: Telematics and Vehicle Diagonstics	**9**			
23.	GPS Navigation ,GPS Structure and Dead Reckoning using Inertial Navigation System	3	C	4	2
24.	Electronic Control System Diagnostics, OBDII, Diagnostics Fault Codes	3	C	5	2

25.	Introduction to Model-based Sensor Failure Detection – Case Study on MAF Sensor calibration	3	C,D	5	2
26	Cycle test-I	1			
27	Cycle test-II	2			
28	Surprise test	1			
	Total contact hours	**45**			

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Study of Automotive electrical layout	2	C,I,O	1	1
2.	Study of voltage regulator, solenoids, Horn and wiper mechanism.	2	C,I,O	1	1
3.	Battery Testing –Hydrometer, Load test, Individual Cell voltage test, Jump Start Principle.	2	C,I,O	1	1
4.	Starter Motor –Continuity test, Insulation Test, Load test.	2	C,I,O	1	1
5.	Alternator Testing –Continuity test, Insulation Test, Load test.	2	C,I,O	1	1
6.	Fault Diagnosis using OBD handheld Devices	2	I,O	5	2,4
7.	Basics of graphical Programming	2	C,I,O	5	3
8.	ADC interfacing for IR Sensor	2	I,O	5	3
9.	PWM Signal generation	2	I,O	5	3
10.	H-Bridge Motor speed and position Control	2	I,O	5	3
11.	UART communication for parking sensor	2	I,O	5	3
12.	I2C for Accelerometer based application	2	I,O	5	3
13.	GPS –Dead Reckoning system	2	I,O	5	3
14.	Study of Controller Area Network (CAN)	2	C,I,O	4	3
15.	Study of Instrument Clusters and communication protocols (LIN,MOST)	2	C,I,O	4	2
	Total contact hours	**30**			

Learning Resources	
Sl. No.	**Text Books**
1.	Tom Denton "*Automobile Electrical and Electronic Systems*" 3rd edition, Elsevier Butterworth-Heinemann 2004.
2.	William.B.Ribbens , "*Understanding Automotive Electronics*" 7th edition Butterworth-Heinemann publications,2012.
3.	Ed Doering "*NI MYRIO Project Essential Guide*",National Technology and Science Press.2013
4.	Automotive electrical and Electronics "*Lab Manual*"
	Reference Books/Other Reading Material
5.	Allan.W.M.Bonnick "*Automotive Computer Controlled System*", Butterworth-Heinemann. 2001
6.	Robert Bosch Gmbh "*Bosch Automotive Electric and Electronics*" 5th edition Springer-Vieweg.2007

Course nature				**Theory + Practical**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
						End semester examination Weightage :	**40%**

15AE309	**Automotive Transmission**			**L**	**T**	**P**	**C**
				2	**2**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose		This course provides the basic knowledge, principle of operation and performance of various components and drives in an automotive transmission system.			
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand the fundamentals, principle of operation and performance of various clutches and gear boxes.	a	e		
2.	Gain the knowledge about various hydrodynamic drives.	a			
3.	Conceive various types of gear boxes used for Automotive transmission	a		j	
4.	Understand the principle of operation and performance of various hydrostatic and electric drives.	a			

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I :Clutch and Gear Box	**8**			
1.	Requirements of transmission system and role of clutch in driving system, Types of clutches and construction and working of single plate, multi plate and cone clutch.	1	C	1	1
2.	Construction and working of centrifugal and semi centrifugal clutch and its operating characteristics.	1	C	1	1
3.	Deriving the equation for torque capacity of a single plate clutch.	1	D	1	1
4.	Problems involving torque capacity and axial force of single plate clutch.	1	I	1	1
5.	Objective and need for a gear box in an automobile and types of gear boxes - working of sliding mesh and constant mesh gear box.	1	C	1	1
6.	Construction and working of synchromesh gear box and principle of synchronizers.	1	C	1	1
7.	Epi-cyclic gear train - performance characteristics at different speeds. Setting top, bottom and intermediate gear ratios, G.P and relation between engine speed and vehicle speed.	1	C	1	1
8.	Problems in gear box involving gear ratios and various gradients and total resistance calculation.	1	I	1	1
	Unit II: Hydrodynamic and Hydro Kinetic Drives	**8**			
9.	Introduction to fluid coupling	1	C	2	1,2
10.	Fluid coupling - Construction and principle of operation	1	C	2	1,2
11.	Drag torque and various drag reducing devices, Performance characteristics of fluid coupling	1	C	2	1,2
12.	Problems on design and torque capacity of fluid coupling	1	D	2	1,2
13.	Torque converter and converter coupling - construction and principle of operation.	1	C	2	2
14.	Multistage torque converter - construction and working.	1	C	3	2
15.	Poly phase torque converter - construction and working.	1	C	3	2
16.	Performance characteristic of multistage and poly phase torque converters.	1	C	3	2
	Unit III : Planetary Gear Trains	**8**			
17.	Principle of working of epi-cyclic gear train	1	C	4	4
18.	Planetary gear box - construction and working	1	C	4	4
19.	Construction and working principle of Ford T Model gear box.	1	C	4	4
20.	Wilson gear box - construction and working.	1	C	4	4
21.	Derivation of gear ratios for Wilson gear box.	1	D	4	4
22.	Cotal electromagnetic transmission - principle and working.	1	C	4	4
23.	Automatic over drive, Calculating the gear ratio for Over drive.	1	C	4	4
24.	Hydraulic control system for Automatic transmission.	1	C	4	4
	Unit IV: Automatic Transmission Applications	**8**			
25.	Layout of automatic transmission system	1	C	4	3
26.	Turbo glide transmission construction and working	2	C	4	3
27.	Power glide transmission - construction	1	C	4	3
28.	Power glide transmission - working	1	C	4	3
29.	ECT- intelligent transmission working principle	1	C	4	3

30.	Automatic transmission with intelligent electronic control systems.	1	C	4	3
31.	Automatic transmission, Hydraulic clutch actuation for Automatic transmission.	1	C	4	3
	Unit V : Hydrostatic Drives and Electric Drives	**9**			
32.	Introduction to hydrostatic drives	1	C	5	6
33.	Working principle and types of hydro static drives	1	C	5	6
34.	Advantages and limitations of Hydrostatic drive	1	C	5	6
35.	Comparison of hydrostatic drive with hydro dynamic drive	1	C	5	6
36.	Construction and working of Janny Hydrostatic drive	1	C	5	6
37.	Introduction to Electric drive and Layout of Electric drive	1	C	5	6
38.	Principle of Early Ward Leonard control system of electric drive.	1	C	5	6
39.	Principle of Modified Ward Leonard control system of electric drive.	1	C	5	6
40.	Advantages, limitations and performance characteristics of electric drive.	1	C	5	6
41.	Cycle test-I	1			
42.	Cycle test-II	2			
43.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Harald Naunheimer , Bernd Bertsche , Joachim Ryborz , Wolfgang Novak "*Automotive Transmission: Fundamentals, Selection, Design and Application*", 2nd Edition, Springer, 2011.
	Reference Books/Other Reading Material
2.	Heldt P.M, "*Torque converters*", Chilton Book Co., 1992.
3.	Newton Steeds & Garrot, "*Motor Vehicles*", SAE International and Butterworth Heinemann, 2001.
4.	CDX Automotive, "*Fundamentals of Automotive Technology, Principles and practice*", Jones & Barlett Publishers, 2013.
5.	SAE Transactions 900550 & 930910.
6.	Crouse W.H, Anglin D.L, "*Automotive Transmission and Power Train construction*", McGraw Hill, 1976.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE376L	**Minor Project-II**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P	Professional Core			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To obtain an hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.

Instructional objectives		**Student Outcomes**						
At the end of the course, student will be able								
1.	To conceptualise a novel idea / technique into a product	c						
2.	To think in terms of multi-disciplinary environment		d					
3.	To understand the management techniques of implementing a project				k			
4.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.			g				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	An Multidisciplinary project to be taken up by a team of maximum of ten students. Development of prototype product, a 3D model, simulation, blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate.		C,D,I	1,2,3,4	
	Total contact hours				

Course nature		**Project – 100% internal continuous assessment**	
Assessment Method (Weightage 100%)			
In-semester	**Assessment tool**	Refer the table	**Total**
	Weightage	Refer the table below	**100%**
		End semester examination Weightage :	**0%**

Assessment component	Expected outcome	Evaluators	Criteria or basis	Marks
Project proposal (Review – I)	A short presentation to be delivered on: • A brief, descriptive project title (2-4 words). This is critical! • The 3 nearest competitors (existing solutions) and price. • Team members name, phone number, email, department/degree program, and year. • A description of the product opportunity that has been identified. To include: Documentation of the market need, shortcomings of existing competitive products, and definition of the target market and its size. • Proposed supervisor / guide	Panel of reviewers	Viability / feasibility of the project Extent of preliminary work done.	**0**
Review II	• Mission Statement / Techniques • Concept Sketches, Design Specifications / Modules & Techniques along with System architecture • Coding	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**20**
Review III	• Final Concept and Model / Algorithm/ Technique • Drawings, Plans / programme output • Financial Model / costing • Prototype / Coding • Final Presentation and Demonstration	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**50**
Final technical Report	A good technical report	Supervisor / Guide	Regularity, systematic progress, extent of work and quality of work	**30**
			Total	**100**

Assessment components

15AE381L	Seminar-II	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Core				
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To enhance the disseminating skills of the student about the current and contemporary research work that are being carried out across the world

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**					
At the end of the course, student will be able							
1.	To understand the research methodology adopted by various researchers	h	i	j			
2.	To mathematically model a problem, critically analyse it and adopt strategies to solve	b	c	e			
3.	To understand and present a well-documented research	e	g				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Guidelines for conducting 15xx390L Seminar for B.Tech 1. Upon registering for the course the student must identify a sub-domain of the degree specialization that is of interest to the student and start collecting research papers as many as possible. 2. After collecting sufficient number of research papers the student must peruse all the papers, meet the course faculty and discuss on the salient aspects of each and every paper. 3. The course faculty, after discussion with the student will approve TWO research papers that is appropriate for presentation. 4. The student must collect additional relevant reference materials to supplement and compliment the two research papers and start preparing the presentation. 5. Each student must present a 15-minute presentation on each of the approved research paper to the panel of evaluators. 6. The presenter must present one research paper within the first half of the semester (6 weeks) and another research paper in the next half of the semester (6 weeks) as per the schedule. 7. All other students registered for the course will form the audience. 8. The audience as well as the evaluators will probe the student with appropriate questions and solicit response from the presenter. 9. The presentation will be evaluated against 7 to 8 assessment criteria by 4 to 5 evaluators. 10. The score obtained through the presentations of TWO research papers will be converted to appropriate percentage of marks. This course is 100% internal continuous assessment.		C,D	1,2,3,4	
	Total contact hours	**30**			

Course nature		**100% internal continuous assessment.**		
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Presentation 1	Presentation 2	**Total**
	Weightage	**50%**	**50%**	**100%**
End semester examination Weightage :				**0%**

15AE386L	Massive Open Online Courses (MOOCs)-II			L	T	P	C
				0	0	3	2
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core					
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To offer students the opportunity to study with the world's best universities by integrating select MOOCs in a regular degree programme and providing students full credit transfer, as per university regulations, if they earn a "Verified / Completion Certificate" and take a proctored examination through a secure, physical testing center.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able					
1.	To apply the concepts, theories, laws, technologies learnt herein to provide engineering solutions.	f	h	i	j

Registration process, Assessment and Credit Transfer:

1. Students can register for courses offered by approved global MOOCs platforms like edX, Coursera or Universities with which SRM partners specifically for MOOCs.
2. Annually, each department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be recognised and accepted for credit transfer.
3. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring the tests, uploading the marks / grades, and collecting and submitting the graded certificate(s) to the CoE, within the stipulated timeframe.
4. Student who desires to pursue a course, from the above department-approved list, through MOOCs must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.
5. The maximum credit limits for course registration at SRM will include the MOOCs course registered.
6. The student must periodically submit the marks / grades obtained in various quizzes, assignments, tests etc immediately to the Faculty Advisor or the Course Coordinator for uploading in the university's academic module.
7. The student must take the final test as a Proctored / Supervised test in the university campus.
8. The student must submit the "Certificate of Completion" as well as the final overall Marks and / or Grade within the stipulated time for effecting the grade conversion and credit transfer, as per the regulations. It is solely the responsibility of the individual student to fulfil the above conditions to earn the credits.
9. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100% , if the credits are transferred, after satisfying the above (1) to (7) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.

Course nature				**Online - 100% internal continuous assessment.**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Quiz	Assignment	Non-proctored / Unsupervised Tests	Proctored / Supervised Test	**Total**
	Weightage	**25%**	**25%**	**10%**	**40%**	**100%**
					End semester examination Weightage :	**0%**

15AE491L	Industrial Module-II	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Core				
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To impart an insight into the current industrial trends and practices				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able					
1.	To obtain an insight into the current industrial trends and practices				
2.	To obtain an insight into the technologies adopted by industries				
3.	To obtain an insight into the technical problems encountered by the industries and the scope for providing solutions.				
4.	To network with industry				

Description of Topic	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1. The department will identify and shortlist few emerging topics that are trending in industry. 2. The department will identify experts from industry who are willing to deliver modules on the shortlisted topics. 3. The identified expert will assist the department in formulating the course content to be delivered as a 30-hour module, prepare lectures notes, ppt, handouts and other learning materials. 4. The department will arrange to get the necessary approvals for offering the course, from the university's statutory academic bodies well before the actual offering. 5. The department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be offered as industry module. 6. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring/supervising/assessment the quizzes, assignments, tests etc, uploading the marks, attendance etc, within the stipulated timeframe. 7. The Student who desires to pursue a course, from the above department-approved list, must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University. 8. The maximum credit limits for course registration at SRM will include the Industry Module also. 9. All academic requirements of a professional course like minimum attendance, assessment methods, discipline etc will be applicable for this Industry Module. 10. The course will be conducted on week ends or beyond the college regular working hours.		C,D,I,O	1,2,3,4	
Total contact hours	**30**			

Course nature				**100% internal continuous assessment.**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage		**50%**

Semester VII

15AE401	Vehicle Dynamics			L	T	P	C
				2	2	0	3
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Design Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To familiarize the students with the fundamental concepts of vehicular dynamics.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the concept of mechanical vibrating system	a	c	e		
2.	Gain knowledge about the suspension and tire related vibrations	a	c	e		
3.	Understand about the stability of vehicle	a	c	e		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Basics of Vibration	**8**			
1.	Classification of vibration, definitions	1	C	1	1,3
2.	Mechanical vibrating systems	1	C	1	1,3
3.	Mechanical vibration and human comfort.	1	C,D	1	1,3
4.	Single degree of freedom free vibration	1	C,D	1	1,3
5.	Forced and damped vibrations	1	C,D	1	3
6.	Magnification factor and transmissibility.	1	C,D	1	3
7.	Modeling and simulation studies	1	C,D	1	3
8.	Vibration absorber. Vibration measuring instruments.	1	C	1	2
	Unit II:Tyres	**8**			
9.	Tyre forces and moments	1	C	2	1,2
10.	Longitudinal force at various slip angles	1	C,D	2	2
11.	Lateral force at various slip angles	1	C,D	2	2
12.	Rolling resistance	1	C	2	2
13.	Relationship between tractive effort and longitudinal slip of tyres	1	C,D	2	2
14.	Cornering property of tyre	1	C	2	2
15.	The magic formula tyre model	2	C,D	2	2
	Unit III:Vertical Dynamics	**8**			
16.	Two degree of freedom system	1	C	1	2,3
17.	Modal analysis	1	C,D	1	1,2
18.	Sources of Vibration	1	C	1	3
19.	Modeling of Passive, Semi-active and Active suspension using Quarter car model	2	C,D	1,2	1,2
20.	Half car model and Full car model	2	C,D	1,2	4,5
21.	Influence of suspension stiffness, suspension damping, and tyre stiffness.	1	C,D	1,2	4,5
	Unit IV: Longitudinal Dynamics	**9**			
22.	Aerodynamic forces and moments	1	C,D	1,3	1,2
23.	Equation of motion. Tyre forces, rolling resistance	1	C,D	2	1,6
24.	Load distribution for three wheeler and four wheeler	2	C,D	2	5,6
25.	Calculation of Maximum acceleration, Reaction forces for Different drives.	2	C,D	2,3	1,2
26.	Braking and Driving torque	2	C,D	2,3	1,2
27.	Prediction of Vehicle performance to braking.	1	C,D	2,3	2,6
	Unit V: Lateral Dynamics	**8**			
28.	Steering geometry. Steady state handling characteristics	1	C,D	3	2,5

29.	Steady state response to steering input. Transient response characteristics	1	C,D	3	1,2
30.	Directional stability of vehicle.	2	C,D	3	1,2
31.	Roll center	1	C,D	3	2,6
32.	Roll axis, Vehicle under side forces.	1	C,D	3	2,6
33.	Effect of suspension on cornering.	2	C,D	2,3	2,5
34.	Cycle test-I	1			
35.	Cycle test-II	2			
36.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Thomas D. Gillespie, "*Fundamental of Vehicle Dynamics"*, Society of Automotive Engineers, USA 1992.
2.	Rajesh Rajamani, "*Vehicle Dynamics and Control"*, 1st edition, Springer, 2005.
	Reference Books/Other Reading Material
3.	Singiresu S. Rao, "*Mechanical Vibrations"* (5th Edition), Prentice Hall, 2010
4.	J. Y. Wong, "*Theory of Ground Vehicles"*, 3rd Edition, Wiley-Interscience, 2001
5.	J.G. Giles, "*Steering, Suspension and Tyres"*, Illiffe Books Ltd., 1968.
6.	Hans B.Pacejka, "*Tyre and vehicle dynamics"*, 2nd edition, Elsevier, 2006.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE402	**Vehicle Body Engineering and Aerodynamics**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE302						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	This course provides the basic knowledge about constructional details of vehicle bodies and its aerodynamic structure.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the fundamentals of various automotive body construction details	a	c	e	j	
2.	Understand the concepts of aerodynamics in body engineering for better style and low drag.	a	c	e	j	

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Car Body Details	**8**			
1.	History - Evolution of vehicle body, Importance of vehicle body, Car Body Terminologies & types of car bodies	1	C	1	1,4
2.	Visibility - Forward visibility, Forward vision measurement and Regulations	1	C	1	1,4
3.	Driver's Visibility, All round visibility of the vehicle - sensors and its functions, Methods of improving visibility	1	C	1	1,4
4.	Safety - factors influencing safety in traffic, Classification - Active & Passive safety	1	C	1	1,4
5.	Active safety - Driving, Conditional, Perceptibility & Operational safety Passive safety - Interior & Exterior safety	1	C	1	1,4
1.	Safety aspects in design - Bumper end, front end, Rear end and	1	C,D	1	1,4

	importance of larger distance				
2.	Air bag, Telescopic/Collapsible Steering column	1	C	1	1,4
3.	Modern Painting process of a passenger car body	1	C	1	1,4
	Unit II: Bus Body Details	**8**			
4.	Introduction to bus bodies, Bus body panels & terminologies	1	C	1	3
5.	Classification of bus body based on distance travelled by the vehicle	1	C	1	3
6.	Classification of bus body based on capacity of the vehicle	1	C	1	3
7.	Classification of bus body based on shape and style of the vehicle	1	C	1	3
8.	Classification of bus body based on types of metal section used	1	C	1	3
9.	Bus body regulations & Sequence of bus building operation	1	C	1	3
10.	Construction of conventional type of bus body, Construction of Integral type of bus body	1	C	1	3
11.	Comparison of Conventional and Integral type of bus body	1	C	1	3
	Unit III : Car Aerodynamics	**8**			
12.	Car Aerodynamics - Introduction and its importance	1	C	2	2
13.	Types of Aerodynamic drag	1	C	2	2
14.	Various Forces and moments influencing drag, Effects of forces and moments	1	C	2	2
15.	Various body optimization techniques for minimum drag	1	C	2	2
16.	Wind tunnel technology - Principle & Construction details	1	C	2	2
17.	Types of wind tunnels	1	C	2	2
18.	Flow visualization techniques	1	C	2	2
19.	Testing with wind tunnel balance (scale models)	1	I	2	2
	Unit IV: Commercial Vehicle Details	**8**			
20.	Commercial vehicles - Introduction	1	C	1	1,4
21.	Classification of commercial vehicle bodies	1	C	1	1,4
22.	Light commercial vehicles and Heavy commercial vehicles	1	C	1	1,4
23.	Dimensions of commercial vehicle driver's seat in relation to various controls	1	C,D	1	1,4
24.	Construction of Tanker and Tipper body, Segmental design of driver's cab	1	C	1	1,4
25.	Design of load carrying capacity of commercial vehicle body	1	C,D	1	1,4
26.	Force exerted by the driver on the controls	1	C	1	1,4
27.	Compactness of Driver's cab	1	C	1	1,4
	Unit V: Commercial Vehicle Aerodynamics	**9**			
28.	Commercial vehicle aerodynamics - Introduction and its importance	1	C	1	4
29.	Effects of rounding sharp front body edges	1	C	1	4
30.	Effects of various cabs on trailer body	1	C	1	4
31.	Fore body pressure distribution	1	C	1	4
32.	Effects of a cab to trailer body	1	C	1	4
33.	Effects of a cab to trailer body roof height	1	C	1	4
34.	Effects of a cab to trailer body gab seals	1	C	1	4
35.	Commercial vehicle drag reduction devices	1	C	1	4
36.	Cab roof deflectors	1	C	1	4
37.	Cycle test-I	1			
38.	Cycle test-II	2			
39.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Pawloski J, " *Vehicle Body Engineering"* - Business Books Ltd.,
2.	Wolf-Heinrich Hucho, *"Aerodynamics of road vehicles",* 4th edition, 2000.
	Reference Books/Other Reading Material
3.	John Fenton, *"Vehicle Body layout and analysis",* Mechanical Engineering Publication Ltd., 1984
4.	Heinz Heisler, *"Advanced Vehicle Technology"*, 2nd edition, Butterworth – Heinemann, 2002.

Course nature				Theory			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle test III	Surprise test	Quiz	Total
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage: 50%							

15AE403	**Alternative Fuels and Emission Control**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE303						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Engine				
Course designed by	Department of Automobile engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	The purpose of the course is to impart adequate knowledge on emission formation & controls, alternative fuels & their use in Automobiles					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the formation of various emission from SI engine and control techniques	a	c			
2.	Understand the formation of various emission from CI engine and control techniques	a	c			
3.	Acquire knowledge about emission measuring instruments and test procedures	a	c			
4.	Gain knowledge about various alcohol and gaseous fuels and their use in SI and CI engines	a	c			
5.	Acquire knowledge about various vegetable oils (Bio Diesel) and their use in CI engines	a	c			

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Emissions From SI Engines and Their Control	**8**			
1.	Emission formation in SI engines (CO, HC and NOx).	1	C	1	1,3
2	Effect of design and operating variables on emission formation	2	C	1	1,3
3	Control techniques -Thermal reactor, exhaust gas recirculation,	2	C	1	1,3
4	Three way catalytic convertor and Charcoal canister control for evaporative emission	2	C	1	1,3
5	Positive crank case ventilation for blow by gas control.	1	C	1	1,3
	Unit II: Emissions From CI Engines and Their Control	**8**			
6	Emission formation in CI engines (HC, CO, NOx, aldehydes, smoke and particulates)	2	C	2	1,3
7	Effect of design and operating variables on emission formation	2	C	2	1,3
8	Control techniques, exhaust gas recirculation, NOx selective catalytic reduction, diesel oxidation catalytic convertor	2	C	2	1,3
9	Diesel particulate filter, NOx versus particulates –trade off	2	C	2	1,3
	Unit III: Emission Measuring Instruments and Test Procedures	**8**			
10	Principle of operation of emission measuring instruments used in SI and CI engines, Measurement of CO2 and CO by NDIR	3	C	2	1,3
11	Hydrocarbon emission by FID, Chemiluminescent analyser for NOx, Liquid and Gas chromatograph	3	C	2	1,3
12	Spot sampling and continuous indication type smoke meters (Bosch, AVL and Hartridge smoke meters) emission test procedures – FTP, Euro and Bharat norms	2	C	2	1,3
	Unit IV: Alcohol Fuels And Gaseous Fuels	**8**			
13	Properties of alcohols, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, dual fuel system	2	C	2	2,4,5

14	Spark assisted diesel engine, surface ignition engine, ignition accelerators, performance, combustion and emission characteristics in SI and CI engines	2	C	2	2,4,5
15	Properties of hydrogen, production and storage methods, safety precautions, biogas production and its properties, properties of LPG and CNG, use	2	C	2	2,4,5
16	Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines	2	C	2	2,4,5
	Unit V: Vegetable Oils	**9**			
17	Various vegetable oils for diesel engines, structure and properties, problems in using vegetable oils in diesel engines	2	C	2	2,4,5
18	Methods to improve the engine performance using vegetable oils-preheating, Esterification , blending with good secondary fuels	2	C	2	2,4,5
19	Semi-adiabatic engine, surface ignition engine, ignition accelerators dual fuelling with gaseous and liquid fuels coils	2	C	2	2,4,5
20	Performance, combustion and emission characteristics of biodiesel fuelled diesel engines.	3	C	2	2,4,5
21	Cycle test-I	1			
22	Cycle test-II	2			
23	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Book**
1	Ganesan V, *"Internal combustion engines"*, 4th edition, Tata McGraw Hill Education, 2012
	Reference Books
2	Michael F. Hordeski, *"Alternative Fuels: The Future of Hydrogen"*, The Fairmont Press, Inc., 2008
3	Rajput R. K, *"A textbook of Internal Combustion Engines"*, 2nd edition, Laxmi Publications (P) Ltd, 2007
4	*"Society of Automotive Engineers"*, *Alternative Fuels: Fuel Cells and Natural Gas*, Society of Automotive Engineers, Incorporated, 2000
5	Thipse S. S, *"Alternative Fuels: Concepts, Technologies and Developments",* Jaico Publishing House, 2010.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE404M	**Multi-Disciplinary Design**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P	Professional Core			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	Students of any specialization at an undergraduate level learn courses related to various sub-domains (Multi-disciplinary) of their specialization individually. They are not exposed to understanding how the various multi-disciplinary fields interact and integrate in real life situations. It is very common that an expert in a particular domain models and designs systems or products oblivious of the impact of other subsystems. This lack of multi-disciplinary thinking is very blatantly visible when the students take up their major project during their final year. This course aims to develop appropriate skills on systemic thinking on how to identify and formulate a problem, decompose the problem into smaller elements, conceptualize the design, evaluate the conceptual design by using scientific, engineering and managerial tools, select, analyze and interpret the data, consideration of safety, socio-politico-cultural, risks and hazards, disposal, regional and national laws, costing and financial model and undertake documentation and finally presentation.

Instructional Objectives		Student Outcomes						
At the end of the course, student will be able								
1.	To subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model	a	c	e	f	i	l	
2.	To rationalize a system architecture or product design problem by selecting appropriate design variables, parameters and constraints	a	c	e	f	i	l	
3.	To design for value and quantitatively assess the expected lifecycle cost of a new system or product	a	c	e	f	i	l	
4.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.	a	c	e	f	i	l	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1	Introduction: Facilitating Multidisciplinary Projects		C,D,I,O	1,2,3,4	
2	Identifying and formulating a problem				
3	System Modelling				
4	Thinking perspectives: Decomposition–Composition Thinking Hierarchical Thinking, Organizational Thinking, Life-Cycle Thinking, Safety Thinking, Risk Thinking, Socio-politico-cultural thinking, Environment thinking				
5	Decomposing a system – Identifying the major sub-systems				
6	Mathematical Modeling and Governing equations for each sub systems				
7	Objectives, Constraints and Design Variables				
8	Conceptual Design				
9	Collaborative Design – Disciplinary teams satisfy the local constraints while trying to match the global constraints set by the project coordinator.				
10	Tools for modeling, designing, analysis, data interpretation, decision making etc				
11	Design Analysis, evaluation and selection				
12	Costing and Financial model				
13	Documentation, reviewing and presentation				
	Total contact hours	**60**			

Learning Resources	
Sl. No.	**References**
1.	**Systems Design and Engineering: Facilitating Multidisciplinary Development Projects** G. Maarten Bonnema, Karel T. Veenvliet, Jan F. Broenink December 15, 2015, CRC Press ISBN 9781498751261
2.	**Exploring Digital Design-Multi-Disciplinary Design Practices,** Ina Wagner , Tone Bratteteig , Dagny Stuedahl, Springer-Verlag London, 2010, ISSN:1431-1496
	Additional references can be included by the respective departments based on the domain and / or theme.

Course nature	Predominantly Practice complimented by theory					
Assessment Method (Weightage 100%)						
In-semester	Assessment tool	Review 1	Review 2	Review 3	Review 4	Total
	Weightage	10%	25%	25%	40%	100%
End semester examination Weightage :						0%

Pedagogy:

Theme or major/broad domains will be announced by the department every semester. Multi-disciplinary designs will be made by the students in groups (group size may be decided by the course coordinator), with the topic of interest falling within the theme or major/broad domains as announced by the department, applying any combinations of the disciplines in engineering. 3D modelling and / or simulation must be used to validate the design.

In a combination of lecture and hands-on experiences, students must be exposed to understand and analyse engineering designs (or products) and systems, their realization process and project management. Analysis of the design criteria for safety, ergonomics, environment, life cycle cost and sociological impact is to be covered. Periodic

oral and written status reports are required. The course culminates in a comprehensive written report and oral presentation. If required guest lecturers from industry experts from the sub-domains may be arranged to provide an outside perspective and show how the system design is being handled by the industry. The Conceive Design Implement Operate (CDIO) principles must be taught to the students.

A full-scale fabrication is not within the purview /scope of this course. Of course this design, if scalable and approved by the department, can be extended as the major project work

This course is 100% internal continuous assessment.

15AE401L	**Vehicle Dynamics Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Co-requisite:	**15AE401**				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Core	Design Engineering			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To understand the various dynamic behavior of road vehicles under various loading conditions and its computer simulation using computer aided tools.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the fundamentals of computer aided tools for numerical simulations.	b	d	e	k	
2.	Improve their ability in solving vehicle dynamics problems using simulation tools.	b	d	e	k	
3.	Equip themselves familiar with lateral and longitudinal dynamics.	b	d	e	k	

Sl. No.	**Description of experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	Introduction to computer Aided simulation tools	3	D,I,O	1	2
2.	Numerical simulation of suspensions parameter optimizations	3	D,I,O	1-2	1-3
3.	Multi body dynamic simulation of half car	3	D,I,O	1-3	1-3
4.	Numerical simulation of steering system	3	D,I,O	1-3	1-3
5.	Multi body dynamic simulation of a HCV	3	D,I,O	1-2	1-3
6.	Suspension test	3	I,O	3	1,3
7.	Steering test	3	I,O	3	1,3
8.	Damper test	3	I,O	3	1,3
9.	Centre of gravity test	3	I,O	3	1,3
10.	Brake test	3	I,O	3	1,3
	Total contact hours	**30**			

LEARNING RESOURCES	
Sl. No.	**REFERENCES**
1.	*Laboratory Manual*
2.	*Computer aided simulation tool tutorials*
3.	Gillespie T, "*Fundamentals of Vehicle Dynamics"*, Society of Automotive Engineers (SAE)", 1992.

Course nature			**Practical**			
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination	**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**	**60%**
				End semester examination Weightage :		**40%**

15AE405L	Vehicle Testing Laboratory			L	T	P	C
				0	0	2	1
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Core	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	This Laboratory course is intended to give the students, experimental knowledge on the performance and testing of vehicles.

Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Perform testing using dynamometers.	b	e	k		
2.	Perform engine analysis using diagnostic systems.	b	e	k		
3.	Conduct wheel balancing and alignment.	b	e	k		
4.	Conduct exhausts gas analysis.	b	e	k		
5.	Adjust timing and test a fuel injection pump.	b	e	k		

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Studying the performance of a two wheeler using Eddy current chassis dynamometer.	3	C, I	1	1-3
2.	Testing of four wheeler using chassis dynamometer	3	I, O	1	1, 4
3.	Determination of slide slip, suspension efficiency, brake efficiency and headlight alignment using car test lane.	3	I	1	2
4.	Engine analysis using engine diagnostic system for gasoline and diesel engine.	3	C, I, O	2	1-3
5.	Wheel balancing, tire removal and fitment.	3	I, O	3	1-3
6.	Wheel alignment	3	I, O	3	1-3
7.	Study of chemiluminescent NO_x analyzer	3	C	4	1-3
8.	Measurement of HC, CO, CO_2 and O_2 using exhaust gas analyzer.	3	I, O	4	1-3
9.	Testing of diesel smoke intensity	3	I, O	4	1-3
10.	Fuel injections pump timing adjustment and testing.	3	I, O	1	1-3
	Total contact hours	**30**			

Sl. No.	References
1.	*Lab Manual*
2.	Giles J.G, "*Vehicle Operation and performance*", Iliffe Books Ltd., London,1989.
3.	Crouse W.H, Anglin D.L, "*Motor Vehicle Inspection*", McGraw Hill Book Co.,1978.
4.	Ganesan V, "*Internal Combustion Engines*", 2nd edition, Tata McGraw HillCo., 2012.

Assessment Method – Practical Component (Weightage 50%)

In-semester	Assessment tool	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination	Total
	Weightage	**40%**	**5%**	**5%**	**10%**	**60%**
						End semester examination Weightage:40%

15AE391L	Industrial Training-II	L	T	P	C
		0	0	2	1

Co-requisite:	NIL		
Prerequisite:	NIL		
Data Book / Codes/Standards	NIL		
Course Category	P	Professional Core	
Course designed by	Department of Automobile Engineering		
Approval	32nd Academic Council Meeting , 23rd July 2016		

Purpose	To provide short-term work experience in an Industry/ Company/ Organisation							
Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able								
1.	To get an inside view of an industry and organization/company				j			
2.	To gain valuable skills and knowledge				j			
3.	To make professional connections and enhance networking	f	g					
4.	To get experience in a field to allow the student to make a career transition			i				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	1. It is mandatory for every student to undergo this course. 2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation. 3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme. 4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organisation as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department. 5. The committee will then assess the student based on the report submitted and the presentation made. 6. Marks will be awarded out of maximum 100. 7. Appropriate grades will be assigned as per the regulations. 8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations. 9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits. 10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO. 11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory.		D, I,O	1,2,3,4	
	Total contact hours				

Course nature	**Training – 100% internal continuous assessment**			
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	**Presentation**	**Report**	**Total**
	Weightage	**80%**	**20%**	**100%**
End semester examination Weightage :				**0%**

15AE496L	Major Project	L	T	P	C
		0	0	24	12
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P	Professional Core			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	The Major Project experience is the culminating academic endeavor of students who earn a degree in their Undergraduate Programs. The project provides students with the opportunity to explore a problem or issue of particular personal or professional interest and to address that problem or issue through focused study and applied research under the direction of a faculty member. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems. This final project affirms students' ability to think critically and creatively, to solve practical problems, to make reasoned and ethical decisions, and to communicate effectively.

Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able								
1.	To provide students with the opportunity to apply the knowledge and skills acquired in their courses to a specific problem or issue.	a	c		e	f		i
2.	To allow students to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals.	a	c		e	f		i
3.	To encourage students to think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues.	a	c		e	f	h	i
4.	To provide students with the opportunity to refine research skills and demonstrate their proficiency in written and/or oral communication skills.	a	c		e	f	g	i
5.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.			d			g	

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	1. The Major project is a major component of our engineering curriculum: it is the culmination of the program of study enabling the students to showcase the knowledge and the skills they have acquired during the previous four years, design a product/service of significance, and solve an open-ended problem in engineering. 2. Each student must register to the project course related to his or her program 3. Major Project course consists of one semester and would be allowed to register only during the final year of study. 4. The Major Project may be initiated during the pre-final semester but will be assessed and credits transferred only during the last semester of study, upon completion of all other degree requirements. Generally the undergraduate major project is a team based one. 5. Each team in the major project course will consist of maximum of 5 students. 6. Each project will be assigned a faculty, who will act as the supervisor. 7. The project shall be driven by realistic constraints like that related to economic, environmental, social, political, ethical, health & safety, manufacturability and sustainability. 8. Each group must document and implement a management structure. Group leadership roles must be clearly identified including who has responsibility for monitoring project deliverables and group coordination.		C,D,I,O	1,2,3,4,5	

	9. A group project may be interdisciplinary, with students enrolled in different engineering degrees, or in Engineering plus other faculties such as Management, Medical and Health Sciences, Science and Humanities. 10. Each student team is expected to maintain a log book that would normally be used to serve as a record of the way in which the project progressed during the course of the session. 11. Salient points discussed at meetings with the supervisor (i.e., suggestions for further meetings, changes to experimental procedures) should be recorded by the student in order to provide a basis for subsequent work. 12. The logbook may be formally assessed; 13. The contribution of each individual team member will be clearly identified and the weightage of this component will be explicitly considered while assessing the work done. 14. A project report is to be submitted on the topic which will be evaluated during the final review. 15. Assessment components will be as spelt out in the regulations. 16. The department will announce a marking scheme for awarding marks for the different sections of the report. 17. The project report must possess substantial technical depth and require the students to exercise analytical, evaluation and design skills at the appropriate level.				
	Total contact hours				

Course nature	**Project – 100 % Internal continuous Assessment**				
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Review 1	Review 2	**Review 3**	**Total**
	Weightage	**10%**	**15%**	**20%**	**45%**
End semester examination	**Assessment Tool**	**Project Report**	**Viva Voce**		
	Weightage :	**25%**	**30%**		**55%**

Department Electives
Manufacturing

15AE221E	Welding and Joining Techniques			L	T	P	C
				3	0	0	3
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

purpose	To acquire the basic knowledge in understanding the welding techniques and also recognize various joining techniques.

Instructional Objectives	**Student Outcomes**				
At the end of the course, student will be able to					
1. To understand the right kind of welding technique suitable for various joints.	a	c	k		
2. To understand the various parameters and requirements for welding processes.	a	e	k		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Welding and Joining Technologies	**8**			
1.	Classification of fusion welding processes	1	C	1	1
2.	Heat source intensity, Heat Input rates	1	C	1	1
3.	Shielding methods	1	C	1	1
4.	Metallurgical effect of weld thermal cycle	1	C	2	1
5.	Residual stresses	1	C	2	1
6.	Formation and Relieving	1	C	2	1
7.	Types of weld joints	1	C	1	1
8.	Edge preparation, cleaning of edges, tack welding	1	C	1	1
	Unit II: ARC Welding and Joining Methods	**8**			
9.	Welding techniques for manual welding	1	C	1	1
10.	Carbon arc welding	1	C	1	1
11.	Submerged arc welding	2	C	1	1
12.	Gas tungsten arc welding	2	C	1	1
13.	Electric slag welding	1	C	1	1
14.	Plasma arc welding	1	C	1	2
	Unit III : Thermal Cutting of Metal	**8**			
15.	Oxygen cutting	1	C	2	1
16.	Flame cut ability of metals, effect of cutting on structure and properties of steel	1	C	2	2
17.	Oxygen lancing machine cutting, Powder cutting	1	C	2	1
18.	Welding of different types of materials, like carbon and alloy steels, cast iron non-ferrous metals and alloys, aluminum	1	C	2	1
19.	Soldering and Brazing: Capillary and welding action	1	C	1	1
20.	Temperature Range	1	C	2	2
21.	Filler Metals and Fluxes	1	C	2	2
22.	Processes and application, Design and strength of joints	1	C	2	2
	Unit IV: Resistance Welding	**8**			
23.	Spot welding and types of equipment	1	C	1	2
24.	Rocker arm press type welding and it's applications	1	C	1	2
25.	Seam welding and its applications	1	C	1	2
26.	Projection welding and its applications, Flash and butt welding applications	1	C	1	2
27.	Gas welding ,fuel gases and flames	1	C	1	2
28.	Torches, Filler metal and Fluxes	1	C	1	2
29.	Backward and Forward welding and filler rod diameter	1	C	1	2

30.	Atomic hydrogen welding and Termite welding.	1	C	1	2
	Unit V: Solid Phase Welding	**9**			
31.	Cold pressure welding	1	C	1	1
32.	Diffusion joining and process variables and its applications,	1	C	1	1
33.	Forge welding, , Ultra sonic welding, Radiation Welding: Laser welding	2	C	1	1
34.	Electron beam welding types of electron gun, spot size beam power	2	C	1	1
35.	Operating voltage, pulse technique, deep penetration and applications	2	C	2	1
36.	Other Joining Techniques for automotive applications	1	C	2	1
37.	Cycle test-I	1			
38.	Cycle test-II	2			
39.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Nadkarni. S. V, "*Modern Arc Welding Technology*", Ador Welding Ltd. Oxford and IBH Publishing, 2005.
2.	William A. Bowditch, Kevin E. Bowditch, Mark A. Bowditch, "*Welding Technology Fundamentals*", Goodheart-Willcox Publisher, 2009.
	Reference Books/Other Reading Material
3	Richard L. Little, "*Welding and welding Technology*", TATA McGraw Hill Publishing Company Ltd, 1973 (2008)
4	Parmar. R. S, "*Welding Engineering And Technology*", Khanna Publishers, 2004

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE222E	**Automotive Component Manufacturing**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire knowledge in understanding the manufacturing processes and functional requirement of automotive components.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand The functional requirement of automotive component for the required manufacturing process.	a			i	
2.	Design considerations for the manufacturing process for various automotive components	a		h		
3.	Select the materials for the components based on its functionality.	a	c			
4.	Understand primary & secondary machining operation. Also special heat treatment & surface coating techniques.	a				k
5.	Automotive welding technique for vehicle chassis	a				k
6.	The final assembly and ergonomics of automotive body	a				k

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction to Automotive Engine Components -I	**8**			
1.	Introduction to automotive Engines-overview of parts, Their function requirement, Material used in the automotive sector	1	C	1,2	1
2.	Manufacturing of an engine block of cylinder head- Functional requirement of an engine block & cylinder head-Materials used in engine block casting. Manufacturing process – Low pressure die casting, High pressures die casting, expendable pattern casting. Machining – Cutting, Milling, Drilling, Boring, Honing, Reaming-Quality consideration during manufacturing-Possible defects during manufacturing.	3	C	1,2,3	1
3.	Manufacturing of Camshaft-Functional requirement of Camshaft, Materials used in Camshaft, Production requirement-Process requirement – Closed die forging, Impression die forging- forging force, and Finishing operations. Heat treatment	2	C	1,2,3	1
4.	Manufacturing of crankshaft-Functional requirement of crankshaft, Materials used in crankshaft manufacturing, Production requirement-Process requirement – Forging, Precision machining - Heat treatment	2	C, D	1,2,3	1
	Unit II: Manufacturing of Automotive Engine Components–II	8			1
5.	Manufacturing of main bearing – Description, Purpose, Material-Production requirement – Consistent wall thickness, Precise crush height, process requirement – Centrifugal casting, Mold material, Consideration for main bearing in centrifugal casting. Surface finishing for main bearing	1	C	1,2,3	1
6.	Manufacturing of main bearing cap-Functional requirement - Material requirement – Special treatment materials for cap - Production requirement-Process requirement – Hot chamber die casting, Cold chamber die casting-Precision drilling operation	1	C	1,2,3	1
7.	Vibration damper-Functional requirement, Description of vibration, Material requirement, Production requirement, Process description. Vacuum casting – Consideration for casting damper-Why vacuum casting? & its advantages	1	C	1,2,3	1
8.	Piston ring & pin-Description - types-Functional requirement-Material-Production requirement-Process requirement	1	C	1,2,3	1
9.	Valves-Description, Functional requirement- Types of valves – Monometallic, Bimetal, Stellied welded, Chrome plate, Nitrate. Process – Cutting, Friction welding (Bimetal Special purpose), Upsetting, Forging, Stellied welding, Heat treatment, Grinding.	1	C	1,2,3	1
10.	Automotive springs-Description, Functional requirement-Manufacturing process – Hot rolling, oil tempering, cold oiling, stress relieving, coil and grinding, nitriding, slot peering, Strain aging	1	C	1,2,3	1,2
11.	Inlet Manifold-Description, Functional requirement-Process – Injection molding, Plastic materials, Injection molding, Injection molds.	1	C	1,2,3	1
12.	Exhaust manifold- Description, Functional requirement- Process – Welded tubular, Investment casting	1	C	1,2,3	1
	Unit III : Manufacturing of Air Filters And Catalytic Converter of Spark Plugs	**8**			
13.	Manufacturing of Air filters-Description of Air filters, Functional requirement of air filters-Materials – Core materials, sealing agents, supporting materials.-Production	1	C	1,3	1
14.	Manufacturing of oil filters-Description of oil filters, Functional requirement of oil filters-Materials-Production	1	C	1,3	1
15.	Manufacturing of ceramic catalytic convertor-Description of ceramic catalytic convertor-Functional requirement-Material properties-Processing – Processing of starting materials, Shaping, sintering, finishing	2	C	1,3	1

16.	Manufacturing of metallic catalytic convertor-Description of ceramic catalytic convertor-Functional requirement-Material properties-Need for honey comb structure is metal catalytic convertor-Methods of forming honey comb	2	C	1,3	1,2
17.	Manufacturing of spark plug-Description of ceramic catalytic convertor-Functional requirement-Material selection-Manufacturing process – Processing of ceramic, forming of electrode, bonding.	2	C	1,3	1,2
	Unit IV: Manufacturing of Glass &Rubber Processing Technology	**8**			
18.	Raw material preparation & melting-Properties of glass -Classification of glass for automotive application-Glass melting furnace- Pot furnace, Day tank, Continuous tank, Electric furnace	1	C	1	2
19.	Shaping process in glass working-Shaping of Glass- Spinning, processing, blowing-Shaping of flat glass – Rolling, float, Drawing of glass tubs-Forming of glass fibers-Centrifugal spraying-Drawing of continuous filaments	2	C	1	2
20.	Heat treatment & finishing-Annealing, Tempered glass -Finishing – Primary, secondary design considerations in glass processing	2	C	4	2
21.	Manufacturing of tyre-functional requirement, material selection, manufacturing process-Compound & mixing, Component Preparation, tyre building, curing and inspection.	3	C	1,4	2
	Unit V: Manufacturing of Automotive Body	**9**			
22.	Automotive materials-Automotive steel grades – High strength & ultra-strength-Stamping aluminum sheet	1	C	1	3
23.	Automotive stamping process & die-die operations & tooling -Blank holder-Draw Beads-Blanking & sharing dies-Binding -Deep drawing-Coating & lubrication	2	C	4	3
24.	Advances in metal forming-Hydro forming & extrusion -Industrial origami : Metal folding – based forming-Flexible stamping procedure	1	C	1,4	3
25.	Automotive TIG welding-Robotic spot welders-Adhesive bonding	1	C	5	3
26.	Advances in automotive welding-Friction the welding-Lack welding-Weld bonding	1	C	5	3
27.	Automotive joining -Joining an automotive frame, Set assembling automotive doors	1	C	5	3
28.	Final assembly-Installation of trim assembly-Installation of the chassis-Final assembly & testing	1	C	6	3
29.	Ergonomics of the final assembly-Mechanical fastening & bolting	1	C	6	3
30.	Cycle test-I	1			
31.	Cycle test-II	2			
32.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Serope Kalpakjian, *"Manufacturing Engineering and Technology",* 6th Edition,Addison-Wesley Publishing Co., Boston, 2010.
2.	Mikell P. Groover *"Fundamentals of Modern Manufacturing",* 4thEdition,John Wiley & Sons Inc, 2010
3.	Mohammed A. Omar, "*The Automotive Body Manufacturing System and Processes*"1st Edition, John Wiley & Sons Inc, USA, 2011.
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Helmi A Youssef, Hassan E El-Holfy, Mahmoud H Ahmed, "*Manufacturing Technology*", CRC Press. 2010.
5.	Benjamin W Niebel,"*Modern Manufacturing Process Engineering*", Mc Graw- HILL international editions, April 1989

Course nature				Theory			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE321E	**Non Destructive Testing Methods**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To enable the students to understand basic principles of NDT and its applications.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the various Non-Destructive Evaluation.	a				
2.	Understand the various testing methods.	a		i		k
3.	Equip themselves familiar with industrial applications.	a	f		j	k

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Overview of NDT	**8**			
1.	NDT Versus mechanical testing, Overview of the Non Destructive Testing Methods	3	C	1	1
2.	The detection of manufacturing defects as well as material characterization. Relative merits and limitations	3	C	1	1
3.	Various physical characteristics of materials and their applications in NDT, Visual inspection, Unaided and aided.	2	C	1	2
	Unit II: Surface NDE Methods	**8**			
4.	Liquid Penetrate Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods	3	C	1,2	1,2
5.	Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods.	3	C	2	1
6.	Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.	2	C	2	1
	Unit III: Thermography and Eddy Current Testing	**8**			
7.	Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation	2	C	2,3	2
8.	Infrared radiation and infrared detectors, Instrumentations and methods, applications.	2	C	3	2
9.	Generation of eddy currents, properties of eddy currents, Eddy current sensing elements.	2	C	3	1
10.	Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.	2	C	3	1
	Unit IV: Ultrasonic Testing (UT) and Acoustic Emission	**8**			
11.	Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method.	3	C	1	2
12.	Straight beam and angle beam, instrumentation, data representation, A-Scan, B-scan, C-scan. Phased Array Ultrasound.	3	C	2	2
13.	Time of Flight Diffraction. Acoustic Emission Technique, Principle, AE parameters, Applications.	2	C	3	2

	Unit V: Radiography	**09**			
14.	Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors. Inverse square, law, characteristics of films.	3	C	1	1
15.	Graininess, density, speed, contrast, characteristic curves, Penetrometers, Exposure charts, Radiographic equivalence.	3	C	2	1
16.	Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography	3	C	2	2
17.	Cycle test-I	1			
18.	Cycle test-II	2			
19.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "*Practical Non-Destructive Testing*", Narosa Publishing House, 2009.
2.	Ravi Prakash, "*Non-Destructive Testing Techniques"*, 1st revised edition, New Age International Publishers, 2010.
	Reference Books/Other Reading Material
3.	ASM Metals Handbook, "*Non-Destructive Evaluation and Quality Control*", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
4.	Paul E Mix, "*Introduction to Non-destructive testing: a training guide*", Wiley, 2nd Edition New Jersey, 2005
5.	Charles, J. Hellier, "*Handbook of Nondestructive evaluation*", McGraw Hill, New York 2001.
6.	ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE322E	**Composite Materials and Structures**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15ME303						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To obtain knowledge, skills and attitudes needed for the optimum design of laminate, sandwich composites and manufacture of advanced composite components and also analyze failure modes of composites.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will familiarize						
1.	Basics of Composite materials	a				j
2.	Computational Techniques for evaluate composite structures	a	e			
3.	Design and evaluation laminate composite plates	a	e			
4.	Design and evaluation sandwich panels	a	e			
5.	Manufacturing processes of composites	a				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction to Composite Materials	**09**			
1.	Definition and Classification of Composites	1	C	1	1
2.	Types of matrices & reinforcements	2	C	1	1
3.	Fiber Types and its properties	1	C	1	1
4.	Matrix materials and its properties	1	C	1	1
5.	Elastic constants for anisotropic	2	C	1	1
6.	orthotropic and isotropic materials , Applications of Composite Materials	2	C	1	1
	Unit II: Methods of Analysis	**10**			
7.	Volume and mass fractions	1	C	2	2
8.	Evaluation of elastic module,	1	C	2	2
9.	Ultimate strengths of a unidirectional lamina	1	C	2	2
10.	Coefficients of thermal and moisture expansion	1	C	2	2
11.	Hook's Law for a two dimensional unidirectional lamina and angular lamina	1	C	2	2
12.	Evaluation of elastic moduli for unidirectional and angle lamina	1	C	2	2
13.	Engineering constants of unidirectional and angle lamina	2	C	2	2
14.	Theories of failure	2	C	2	2
	Unit III: Laminated Composite Plates	**8**			
15.	Governing differential equation for a general laminate	2	C, D	3	1
16.	Angle ply and cross ply laminates	3	C, D	3	1
17.	Failure criteria for composites	3	C, D	3	1
	Unit IV: Sandwich Panels	**06**			
18.	Basic concepts	1	C	4	3
19.	Face , Core and adhesive Materials	1	C	4	3
20.	Symmetric orthotropic sandwich laminated plates	1	C	4	3
21.	Asymmetric orthotropic sandwich laminated plates	2	C	4	3
22.	Failure modes of sandwich panels	1	C	4	3
	Unit V: Composites Manufacturing	**8**			
23.	Moulding process for Polymer Matrix Composites	2	C	5	4,5
24.	Fabrication processes for Metal Matrix Composites	2	C	5	4,5
25.	Fabrication processes for Ceramic Matrix Composites	2	C	5	4,5
26.	Machining of Composites	1	C	5	5
27.	Joining techniques	1	C	5	5
28.	Cycle test-I	1			
29.	Cycle test-II	2			
30.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Calcote, L R. "*The Analysis of laminated Composite Structures*", Von – Noastrand Reinhold Company, New York 1998.
2.	Jones, R.M., "*Mechanics of Composite Materials*", McGraw-Hill, Kogakusha Ltd., Tokyo, 2nd edition, 1998
	Reference Books/Other Reading Material
3.	Autar K Kaw, "*Mechanics of Composite Materials*", Second Edition, CRC Press, New York, 2009
4.	Sanjay K Mazumdar, "*Composites Manufacturing: Materials, Product and Process Engineering*", CRC Press, New York, 2010.
5.	Deborah D L Chung, "*Composite Materials: Science and Applications Functional Materials for Modern Technologies*", Springer Verlag, London, 2010

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE323E	Non Traditional Machining Techniques			L	T	P	C
				3	0	0	3
Co-requisite:	NIL						
Prerequisite:	15AE201J						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department Of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire knowledge in understanding the characteristics of non-traditional/conventional and hybrid machining process.

Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand The wide range of Non Traditional machining process	a					
2.	Do usage of water jets, ice jets & abrasives to cause mechanical abrasion for material removal. Also material removal mechanism,	a	c				
3.	Mechanism of chemical dissolution that controls the rate of material removal	a	c			i	j
4.	Mechanism of chemical dissolution that controls the rate of material removal	a				i	j
5.	Hybrid nontraditional machining techniques, which offers the advantage of two systems.	a		d			
6.	Mechanism of triple action hybrid machining	a		d		i	j

Session	Description of Topic	Contact hours	C, D-I-O	IOs	Reference
	Unit I: Mechanical Machining Process	**7**			
1.	Introduction to non-traditional machining.-definition, types, complexity of the product, competitive industrial scenario. Ultrasonic machining-machining system, removal process, factors affecting material removal rate, accuracy & surface quality, application	2	C	1	1
2.	Introduction to water jet machining-machining system, process parameters, applications, advantages & disadvantages.	1	C	1,2	1
3.	Introduction to Abrasive Jet Machining-machining system, material removal rate, applications, advantages & limitations.	1	C	1,2	1
4.	Introduction to Abrasive Water Jet Machining-machining system, applications, process capabilities.	1	C	1,2	1
5.	Introduction to Ice Jet Machining-machining system, application & process capabilities	1	C	1,2	1
6.	Introduction to Abrasive Finishing-machining system, material removal process & applications	1	C	1,2	1
	Unit II: Chemical & Electro Chemical Machining Processes	**9**			
7.	Introduction to Chemical Milling-Tooling, process parameter, material removal rate, accuracy, surface finish, advantages, limitations and applications.	1	C	3	1,2
8.	Introduction to Photochemical milling-Process description, applications, advantages over chemical milling	1	C	3	1,2
9.	Introduction to Electro Polishing-Process parameters, applications & process limitations	1	C	3	1,2
10.	Introduction to Electrochemical Machining (ECM)-Principles of electrolysis, theory of ECM, Equipment, working, process characteristics, process control, applications, micro ECM,	1	C	3	1,2

	advantages & disadvantages, & environmental impacts				
11.	Electrochemical Drilling-Process configuration, working & applications.	1	C	3	1,2
12.	Shaped Tube Electrolytic Machining-Process configuration, process parameter, capabilities, applications, advantages & limitations	1	C	3	1,2
13.	Electro stream Drilling-Process configuration, process capabilities & applications.	1	C	3	1,2
14.	Electrochemical Jet Drilling-Process configuration, working & applications.	1	C	3	1,2
15.	Electrochemical Deburring-Mechanism of deburring, process configuration, working, advantages & applications.	1	C	3	1,2
	Unit III: Thermal Machining Processes	**7**			
16.	Introduction to Electro Discharge Machining (EDM)-Mechanism of material removal, machining system, material removal rate, surface integrity, heat affected zone, applications, advantages & limitations	1	C	4	1,2
17.	Electro Discharge Machining automation Process control Environmental Impact	1	C	4	1,2
18.	Introduction to Laser Beam Machining-material removal mechanism, applications, advantages & limitations	1	C	4	1,2
19.	Introduction to Electron Beam Machining-material removal mechanism, applications, advantages & limitations	1	C	4	1,2
20.	Introduction to Plasma Beam Machining-material removal rate & mechanism, accuracy & surface quality applications, advantages & limitations.	2	C	4	1,2
21.	Introduction to Ion Beam Machining-material removal rate, accuracy & surface quality applications.	1	C	4	1,2
	Unit IV: Hybrid Electro Chemical Machining Process	**7**			
22.	Introduction to Electro Chemical Grinding-material removal rate and mechanism, accuracy and surface quality applications, advantages & limitations. .	1	C	5	1,3
23.	Introduction to Electro Chemical Honing-process characteristics & application.	1	C	5	1,3
24.	Introduction to Electro Chemical super finishing-material removal rate & mechanism, accuracy & surface quality applications, advantages & limitations	2	C	5	1,3
25.	Introduction to Electro Chemical Buffing-process characteristics, material removal process & application.	1	C	5	1,3
26.	Introduction to Ultra Sonic Assisted ECM-process characteristics, material removal process & application.	1	C	5	1,3
27.	Introduction to Laser Assisted ECM-process characteristics, material removal process & application.	1	C	5	1,3
	Unit V: Hybrid Thermal Machining Process	**11**			1,3
28.	Introduction Electro erosion Dissolution Machining-function of the hybrid system, working principles, process control, application, advantages & limitations	1	C	6	1,3
29.	Introduction to Electro Discharge Grinding- function of the hybrid system, working principles, process control, application, advantages & limitations	1	C	6	1,3
30.	Introduction to Abrasive Electro Discharge Machining- function of the hybrid system, working principles, process control, application, advantages & limitations	2	C	6	1,3
31.	Introduction to EDM with ultrasonic Assistance- function of the hybrid system, working principles, process control, application, advantages & limitations	2	C	6	1,3
32.	Introduction to Electro Chemical Discharge Grinding- function of the hybrid system, working principles, process control, application, advantages & limitations	2	C	6	1,3

33.	Introduction to Brush Erosion- Dissolution Mechanical machining - function of the hybrid system, working principles, process control, application, advantages & limitations	3	C	6	1,3
34.	Cycle test-I	1			
35.	Cycle test-II	2			
36.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Hassan Abdel-Gawad El-Hofy*"Advanced Machining Processes"*, The McGraw –Hill companies, 2005.
2.	Mikell P. Groover *"Fundamentals of Modern Manufacturing"*, 4thEdition,John Wiley & Sons Inc, 2010
	Reference Books/Other Reading Material
3.	Helmi A Youssef, Hassan E El-Holfy, Mahmoud H Ahmed, "*Manufacturing Technology*", CRC Press. 2010.
4.	Benjamin W Niebel,"*Modern Manufacturing Process Engineering*", Mc Graw- HILL international editions

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE324E	**Industrial Engineering and Operational Research**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	This course provides the knowledge to the students be able to describe productivity and its improvement techniques, identify the methods in work study, work measurement and ergonomic aspects in work study.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	To provide students an insight into the concepts of industrial engineering and organization	a	e	g	k	
2.	Apply the PERT/CPM for a constraint based problem of service/Manufacturing	a	e	j	k	

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Industrial Organisation	**6**			
1.	Introduction to Industrial Engineering, Concepts,	1	C	1	2
2.	History and Development of Industrial Engineering	1	C	1	2
3.	Roles of an Industrial Engineer	1	C	1	1
4.	Functions of Industrial Engineering department and its organization	2	C	1	1
5.	Qualities of an Industrial Engineer	1	C	1	1
	Unit II: Productivity and Work Study	**10**			
6.	Productivity concept, Definitions of productivity	1	C	1	4
7.	Productivity Measurement at national, Industrial and enterprise level	1	C	1	4
8.	Benefits of higher productivity , Productivity in the individual enterprise	1	C	1	4
9.	Productivity of land ,Buildings ,Machines and Manpower	1	D	1	4

10.	Factors contributing to productivity improvement techniques .,Management of productivity	1	D	1	4
11.	Prerequisites of conducting a work study	1	C	1	4
12.	The influence of working conditions on work study	1	C	1	4
13.	Factors affecting working conditions, occupational safety and health	1	C	1	4
14.	Fire prevention and protection, Lightning and climate conditioning	1	C	1	4
15.	Introduction to Ergonomics, Arrangement of working time	1	C	1	4
	Unit III: Work Design and Plant Layout	**8**			
16.	Introduction to work design	1	C	1	2
17.	Work design for increased productivity	1	D	1	2
18.	Concept of job enlargement ,Job enrichment and job rotation	2	C	1	3
19.	Effective job design consideration technological and behavioral factors	1	D	1	3
20.	Plant location and factors	1	C	1	1
21.	Plant layout Types, Need of layout, Factors influencing the layout	1	C	1	1
22.	Tools and techniques for developing layout, process chart ,flow diagram	1	C	1	1
	Unit IV: Introduction and Decision Theory	**8**			
23.	Origin and development of Operations research (OR)	1	C	1	5
24.	Scope of Operations Research (OR) ,General Methodology of OR	1	C	1	5
25.	Applications of OR to Industrial problems, Concept on OR model building	2	D	1	5
26.	Limitations of Operations Research ,Linear Programming Problem, Formulation of LPP	1	D	1	5
27.	Decision process, Steps in decision theory approach	1	C	1	5
28.	Decision making conditions, Decision trees	1	C	1	5
29.	Decisions under uncertainty conditions	1	C	1	5
	Unit V: Network Analysis and Replacement Theory	**9**			
30.	Introduction, Basic Difference between PERT and CPM	1	C	2	5
31.	Network diagram, Event, Activity, Defects in network	2	C	2	5
32.	Probability of completion of project	1	C	2	5
33.	Cost analysis and crashing the network	1	D	2	5
34.	Introduction of replacement theory	1	C	2	7
35.	Failure mechanism of item	1	C	2	7
36.	Assumptions of replacement theory	1	C	2	7
37.	Replacement decisions, Types of replacement problem	1	C	2	7
38.	Cycle test-I	1			
39.	Cycle test-II	2			
40.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	O.P. Khanna "*Industrial Engineering and management*", Dhanpat Rai Publisher.
2.	Buffa E.S., "*Modern Production"*,John Wiley & Sons,2009
	Reference Books/Other Reading Material
3.	"*Industrial Engineering and Production management*", Martand Telsang, S. Chand publisher
4.	"*Work study*", ILO, Second Edition, Oxford and IBH Publishing
5.	Premkumar Gupta and Hira,"*Operation Research*",Third Edition S Chand Company Ltd.,New Delhi
6.	Kumar.B,"*Industrial Engineering and management*".9 th edition,Khanna publishers,New Delhi,2005
7.	Pannerselvam.k,"*Operation Research*",Prentice Hall of India,2002

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE325E	Agile Manufacturing (LEAN)			L	T	P	C
				3	0	0	3
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

PURPOSE	To acquire knowledge in understanding the functional and competition behavior in manufacturing industries, Lean concepts, inventory management systems. And acquiring knowledge in industrial automation technique for shop floor control.

Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to understand							
1.	The manufacturing system and operation in terms of economic and technology.	a					
2.	The manufacturing categories, material handling and manufacturing product	a	c				
3.	The industrial automation levels and its functional requirement	a					
4.	The importance of supply chain management and its vital role in making the system Lean	a		d	k		
5.	The role of MRP & MRP II in Production planning	a	c				
6.	The concepts of Lean production and it functional requirement	a	c		k		
7.	The importance of Agility in the manufacturing industry and able to differentiate Lean Versus Mass Versus Agile manufacturing	a	c		k		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction to Manufacturing Operations	**8**			
1.	Definition of Manufacturing Alternate Definition of Manufacturing system as Technological and Economic Process Comments – Remarks Manufacturing Industries & Products Manufacturing Categories –Primary – Secondary – Territory Continuous & Batch Production – Discrete manufacturing industry Manufacturing Products – Materials, Typical Product	1	C	1	1
2.	Manufacturing Operation -Processing & Assembly operations-Material handling-Inspection & testing-Coordination & testing-Process, Objective, Working & Stages of operations	1	C, D	1,2	1
3.	Product & Production Relationship-Production quantity & product variety - Complexity of assembled products-Complexity of individual parts - operations, functions, capabilities, limitation & examples	2	C, D	2	1
4.	Production Concept & Mathematical Models -Production rate-Production capacity -utilization & availability of facility - Manufacturing Lead time-Work in Process-objective, Operations, Functions & examples	2	C, D,I	2	1
5.	Costs of Manufacturing Operations-Fixed & variable cost-Definition, cost equation & application-Direct Labor- Definition, Equation, Application & Examples-Material & overhead-Factory & cooperate.-Estimating manufacturing Cost & establishing selling price-Cost of Equipment	2	C, D,I	2	1
	Unit II: Manufacturing System	**8**			
6.	Manufacturing System- Definition Material Handling- Definition Human Resource Manufacturing system in large production system	1	C	1	1
7.	Components of manufacturing system-Various components-Production machines, Tools, fixtures & material handling system	2	C	1	1

	(Loading & Unloading, Positioning & transport). -Computer systems to coordinate the manufacturing system (Operations & functions)-Human workers				
8.	Classification of Manufacturing systems Factors – Types of operation performed- no. of work stations & layout-level of automation- product variety.	2	C, D	2,3	1
9.	Overview of Classification of manufacturing systems -single station-multi station-production lines	2	C, D	2,3	1
10.	Learning curves of manufacturing progress-Definition - learning rates for typical operations	1	C	3	1
	Unit III: Supply Chain Management, Production Planning & Control System	**8**			
11.	Importance of supply chain-Definition-in terms of competitive industrial revolution Relying on Suppliers-downside-upside	1	C	4	1
12.	Supply chain management-Physical supply chain -management philosophy	1	C	4	1
13.	Purchasing -changing roles-requirement specifications -suppliers, assessment, selection & contracting -managing supplier relationship	2	C	4	1
14.	Material Requirement Planning (MRP)-inputs to MRP, Bill of materials, Structure of MRP, Product Structure, working-Examples, output & benefits of MRP	1	C, D,I	5	1,2
15.	Capacity Planning Shop Floor Control- order release, scheduling & Progress. Data collection.	1	C	5	1,2
16.	Inventory Control- Order point inventory system, work in process (WIP) inventory cost	1	C	5	1,2
17.	Manufacturing Resource Planning II (MRP II)- Definition, structure, working & application	1	C	5	1,2
	Unit IV: Lean Production : JIT, Value Added and Waste Elimination	**8**			
18.	Introduction to lean production -importance- Components of lean production [Minimizing waste, perfect first time quality, flexible production line, continuous improvement] –Definitions, Functions, & Principles.	2	C	6	1,3
19.	Smart inventory waste minimization: JIT- Concept - goals [waste of over production, waste of waiting, waste of transportation, waste of processing, waste of motion, waste of making defective parts	2	C	6	1,3
20.	Objectives of JIT	1	C	6	1,2,3
21.	Ingredients of JIT	1	C	6	1,2,3
22.	Quality & Quantity principles of JIT	1	C	6	1,2,3
23.	Primary quantity JIT principles	1	C	6	1,2,3
24.	JIT implementation	1	I	6	1,2,3
	Unit V: Agile Manufacturing	**9**			
25.	Introduction -Definition -Organize to master change -leverage the impact of People & information-cooperate to enhance competitiveness-enrich the customers	1	C	7	1,2
26.	Market force & agility.-Intensifying competition -fragmentation of mass market-cooperative business relationship-Changing customer expectation	2	C	7	1,3
27.	Reorganizing the production system for agility-product design -marketing -production operation	3	C	7	1,3
28.	Agility versus Mass production	2	C	7	1,3
29.	Comparison of Lean & agile production	1	C	7	1,3
30.	Cycle test-I	1			
31.	Cycle test-II	2			
32.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl.	**Text Books**

No.	
1.	Mikell P. Groover *"Automation, Production System & Computer Integrated Manufacturing ",* 4thEdition,John Wiley & Sons Inc, 2002
2.	John M. Nicholas "*Competitive Manufacturing Management*" 9th Edition, TATA McGraw Hill editions,2001
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	S.R.K. Prasad, R. Prabhakar, S. Dhandapani, V. Selladurai " *Intelligent Flexible Autonomous Manufacturing Systems*", TATA McGraw- Hill Publishing Company Limited, 2000.
4.	M. P. Chowdiah, Gopinath Gargesa, V. Arun Kumar, "*Agile Manufacturing*", TATA McGraw- Hill Publishing Company Limited, 1996.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE326E	**Advanced Manufacturing Process**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE201J						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire knowledge in advanced manufacturing process and understanding the competitive industrial revolution that will leads to the development of innovative & improved product.						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand the advanced metal forming process and its current role in the industrial & automotive applications.	a					
2.	Forming, Shaping and strengthening of glass. Also Processing of Plastics and Composites	a	c				k
3.	Fabrication of microelectronics and role of microelectronics in industrial revolution	a					
4.	Understand the need of low temperature joining and difference in permanent and temporary joining. Also various surface treatment process.	a		e		i	
5.	The importance of additive manufacturing and process involved in it.	a			f		

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Advanced Metal Forming Process	8			
1.	Why do we need advanced Manufacturing Process? Advanced Manufacturing process –Remarks. Introduction to Powder Metallurgy-Description about Powder Metallurgy Need & role of Powder Metallurgy in Automotive Industry, Automotive Parts.	2	C	1	1,2
2.	Production of Metal Powders Properties of Metal Powder- Particle Size, Distribution, Shape	1	C	1	1,4
3.	Blending of Metal Powders- Purpose of Blending, Geometry of Blending Equipment, Hazards in Blending. Compaction of Metal powders - Purpose Isotactic pressing – Hot & Cold Shaping Process – Metal injection molding, Rolling, Spray Deposition- Defects	2	C, D	1	1,4
4.	Sintering- Purpose, Process, Mechanism and Properties of Sintered Parts Secondary & Finishing Operations- Purpose Coining, Forging, Machining, Heat treating, Impregnation, Infiltration & Plating	1	C	1	1,4

5.	Dent Resistance of Sheet metals – dent formation & automotive application. Fabrication of Honey Comb Structure for Catalytic Convertor - need and method of forming	1	C	1	1,4
6.	Super plastic Forming – Super plasticity - Properties, advantages & process – Diffusion bonding/ super plastic forming.	1	C	1	1,4
	Unit II: Composites, Plastics & Glass: Forming, Shaping &Equipment	**8**			
7.	The structure, General properties, Types & Composites in automotive applications, Plastics & Glass	1	C	2	1,3
8.	Processing of Polymer Matrix, Metal Matrix & Ceramic Matrix Composites	2	C	2	1,3
9.	Forming & Shaping of Plastics. Extrusion, Injection Molding, Blow Molding, Rotational Molding, Thermoforming, Compression molding & Transfer Molding- Principle, Process & Process Capabilities	2	C, D	2	1,3
10.	Economics of Processing Plastics & Composites	1	C, D	2	1,3
11.	Forming & shaping of Glass	1	C	2	1,3
12.	Strengthening Technique for Glass	1	C	2	1,3
	Unit III: Fabrication of Microelectronic Devices	**8**			
13.	Role of Electronics in Industrial Revolution Integration of Electronics in Automotive Industry Remarks - Comment	1	C	3	1
14.	Semiconductors & Silicon- Structure, Physical Properties, Working, Advantages & types	1	C	3	1
15.	Wafer Formation & preparation- Single Crystal growing techniques, Slicing of wafers Geometry of wafers	1	C	3	1
16.	Film Deposition & Oxidation techniques – Physical Vapor Deposit and Chemical Vapor Deposit	1	C	3	1
17.	Photolithography – Principle, Process, Types & working	1	C	3	1
18.	Etching – Need, Types, Principle, Process & Working	1	C	3	1
19.	Diffusion & Ion Implantation - Principle, Process & Working	1	C	3	1
20.	Wire Bonding-Packaging- Yield- Reliability	1	C	3	1
	Unit IV: Low Temperature Joining Process & Surface Technology	**8**			
21.	Brazing, Soldering & Adhesion Bonding- Need, Importance, Types, Operations & application	1	C	4	1,4
22.	Threaded Fasteners, Rivets & eyelets- Need, Configuration, Assembly & application	1	C	4	2
23.	Shrink & expansion fits- need, application & assembly Snap rings- need, application & assembly Stitching, Stapling, Sewing & Cotter Pin- need. Assembly, Design importance & application	1	C	4	2
24.	Joining of Plastics Joining of ceramics Joining of glass	1	C	4	2
25.	Surface Treatment- need, surface structure, integrity &texture. Mechanical surface treatment – shot peening, laser shot peening, water jet peening, ultra-sonic peening, surface rolling & explosive hardening.	2	C	4	2
26.	Cladding, case hardening, hard facing & spark hardening- objective, process & working.	1	C	4	2
27.	Thermal spraying – need, materials, types, process & working	1	C	4	2
	Unit V:Additive Manufacturing	**9**			
28.	Introduction- importance of Rapid Prototyping, Advantages and classification of RPT based on Materials- Liquid, Powder & solid based process.	1	C	5	2
29.	Liquid based techniques- Stereo lithography, Solid Ground Curing, Multi Jet Modeling, Ballistic particle, shape deposition manufacturing, liquid thermal polymerization.	4	C	5	2
30.	Powder based techniques- selective laser sintering, laser engineered net shaping, fused deposition machining, 3D printing.	2	C	5	2

31.	Solid based techniques- Solid foil polymerization & laminated object modeling.	2	C	5	2
32.	Cycle test-I	1			
33.	Cycle test-II	2			
34.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Serope Kalpakjian, *"Manufacturing Engineering and Technology",* 6th Edition, Addison-Wesley Publishing Co., Boston, 2010.
2.	Mikell P. Groover *"Fundamentals of Modern Manufacturing",* 4thEdition,John Wiley & Sons Inc, 2010.
	Reference Books/Other Reading Material
3.	Benjamin W Niebel,"*Modern Manufacturing Process Engineering*", Mc Graw- HILL international editions,April 1989.
4.	Helmi A Youssef, Hassan E El-Holfy, Mahmoud H Ahmed, "*Manufacturing Technology*", CRC Press. 2010.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE421E	**Computer Integrated Manufacturing**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To enable the students to understand basic principles of CIM and its elements.						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand the basic components of CIM.	a					k
2.	Enable the knowledge about group technology and CAPP.	a		e	j		k
3.	Equip themselves familiar with shop floor and functions FMS and application.	a	d	e	j		k
4.	Familiarize with CIM implementation.	a					k
5.	Expose to the concept Database management in CIM.	a	d				k

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Introduction to CIM	**08**			
1.	The meaning and origin of CIM- the changing manufacturing and management scene - External communication	2	C	1	1
2.	Islands of automation and software-dedicated and open systems. Manufacturing automation protocol - product related activities of a company	3	C	1	1
3.	Marketing engineering - production planning - plant operations - physical distribution- business and financial management.	3	C	1	2
	Unit II: Group Technology and Computer Aided Process Planning	**9**			
4.	History of group technology ,role of G.T. in CAD/CAM integration, part families, classification and coding	2	C	1,2	1.2
5.	DCLASS and MICLASS and OPITZ coding systems-facility design using GT.	3	C	2	1

6.	Benefits of G.T. cellular manufacturing. Process planning - role of process planning in CAD/CAM integration	2	C	2	1
7.	Approaches to computer aided process planning - variant approach and generative approaches - CAPP process planning systems.	2	C	2	2
	Unit III: Shop Floor Control And Introduction of FMS	**8**			
8.	Shop floor control-phases ,factory data collection system and automatic identification methods	2	C	2,3	2
9.	Bar code technology-automated data collection system	1	C	3	2
10.	FMS, components of FMS, types of FMS.FMS workstation ,material handling and storage systems	3	C	3	1
11.	FMS layout -computer control systems-application and benefits.	2	C	3	1
	Unit IV: CIM Implementation and Data Communication	**9**			
12.	CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram	2	C	4	2
13.	CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture- Product data management	2	C	4	2
14.	CIM implementation software. Communication fundamentals-local area networks –topology.	3	C	5	2
15.	LAN implementations - network management and installations.	2	C	4	2
	Unit V: Open System and Database for CIM	**7**			
16.	Open systems-open system inter connection - manufacturing automations protocol and technical office protocol (MAP /TOP)	3	C	5	1
17.	Development of databases -database terminology- architecture of database systems-data modeling and data associations	3	C	4	1
18.	Relational data bases - database operators - advantages of data base and relational database.	1	C	5	2
19.	Cycle test-I	1			
20.	Cycle test-II	2			
21.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Mikell.P.Groover "*Automation, Production Systems and computer integrated manufacturing*",4th edition Pearson Education 2014.
2.	Kant Vajpayee. S., "*Principles of Computer Integrated Manufacturing*", Prentice Hall of India, 1999
	Reference Books/Other Reading Material
3.	Roger Hanman "*Computer Intergrated Manufacturing*", Addison – Wesley, 1997.
4.	Mikell.P.Groover and Emory Zimmers Jr., "*CAD/CAM*", Prentice Hall of India Pvt. Ltd., New Delhi-1, 2008
5.	Yoremkoren, "*Computer Integrated Manufacturing System*", McGraw-Hill, 1983.
6.	Radhakrishnan P, SubramanyanS.andRaju V., "*CAD/CAM/CIM*", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE422E	**Process Planning and Cost Estimation**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	15AE201J				
Data Book / Codes/Standards	NIL				

Course Category	P	Professional Elective	Manufacturing Engineering
Course designed by	Department of Automobile Engineering		
Approval	32nd Academic Council Meeting , 23rd July 2016		

Purpose	This course provides the basic knowledge about process planning, cost estimation and costing are the most critical factors for the continued success of a manufacturing enterprise. This subject provides the idea to determine of cost estimates and that they work with professional cost accountants to obtain realistic cost estimates

Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Make cost estimation for various products after process planning	a	e		
2.	Understand the process planning concepts	a		k	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I:Work Study and Ergonomics	**9**			
1.	Method study, Definition	1	C	2	2
2.	Objectives of Work study, Objectives of Method study	1	C	2	2
3.	Basic Procedure for Method Study (Select, Record, Examine, Develop, Define, Install and Maintain)	1	C	2	2
4.	Recording Techniques used in Method Study	1	C	2	2
5.	Work Measurements, Objectives of work Measurements	1	D	2	2
6.	Work Sampling, Analytical Estimating	1	D	1	2
7.	Ergonomics	1	C	2	2
8.	Ergonomics Principles Applied to Instrument Design and Control	1	C	2	2
9.	Ergonomics Principles Applied to Machines and Controls	1	D	2	2
	Unit II: Introduction to Process Planning	**8**			
10.	Introduction to manufacturing system-Fundamental concepts & Details of Basic Manufacturing process	1	C	2	3
11.	Introduction to process planning-Basic concepts, Process selection and analysis	1	C	2	3
12.	Details of process plan, process charts and route sheets	1	D	1	3
13.	Process planning methods-Introduction to manual and computer aided process planning & its approaches	1	C	1	3
14.	Manual process planning-Basic procedure, merits & demerits, applications and comparisons,	1	C	1	3
15.	Case study-Preparation of manual process plan for four stroke petrol engine assembly, Computer aided process planning-Types, Basic procedure, merits & demerits, application and comparisions	1	C	1	4
16.	Process analysis-Break even analysis & It's objectives	1	I	1	3
17.	Statistical process control-Process capability analysis using process control charts	1	C	1	4
	Unit III: Cost Estimation	**8**			
18.	Objectives of cost estimation-Types and fundamentals of costing and cost accounting methods	1	C	2	2
19.	Types of estimates	1	C	2	1
20.	Methods of estimates ,Data requirements & Sources	1	C	1	1
21.	Introduction to costs & Expenses-Elements of costs & It types	1	C	1	3
22.	Cost ladder, Direct and indirect expenses	1	I	1	3
23.	Introduction and comparison of factory ,administrative ,selling & distribution expenses	1	D	2	3
24.	Estimation of Direct Material and labour cost and problems	1	D	1	3
25.	Estimation of overhead expenses and problems, Depreciation analysis and problems	1	D	1	3
	Unit IV: Production Cost Estimation	**8**			

26.	Estimation of material cost	1	D	1	1
27.	Estimation of labor cost & Overheads	2	D	1	1
28.	Cost estimation in foundry shop-Foundry basics-Methods of casting, Casting tools and accessories	2	D	1	3
29.	Estimation of pattern cost and sample problems	2	D	1	3
30.	Estimation of casting cost and sample problems	1	D	1	3
	Unit V:Estimation of Machining Times & Costs	**8**			
31.	Introduction to machine tools-Lathe, Drilling, Milling and Grinding machines	1	C	2	5
32.	Estimation of machining time for basic lathe operation-Turing ,Facing, Threading and Chamfering	1	D	1	3
33.	Estimation of machining time for drilling and boring operations –sample problems	2	D	1	3
34.	Estimation of machining time for milling operation-Sample problems	2	D	1	3
35.	Estimation of machining time for Grinding operation-sample problems	2	D	1	3
36.	Cycle test-I	1			
37.	Cycle test-II	2			
38.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Sinha.B.P., "*Mechanical Estimation and Costing*", Tata McGraw-Hill, Publishing Co.,1995
2.	Adithan,M, "*Process planning and cost estimation*", New Age International(P) Limited,2007
	Reference Books/Other Reading Material
3.	Nanua Singh, "*System Approach to computer Integrated Design and manufacturing*", John Wiley & Sons, New York,1996
4.	Chitale,A.K.,and Gupta,R.C., "*Product Design and Manufacturing*", Prentice Hall of India, New Delhi,1997
5.	Narang,G.B.S. and Kumar,V., "*Production and planning*",Khana Publishers, New Delhi,1995

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE423E	**Manufacturing Systems and Simulation**			**L**	**T**	**P**	**C**
				3	**0**	**0**	3
Co-requisite:	NIL						
Prerequisite:	15AE201J						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire the knowledge in simulating manufacturing systems, to match the global competency and evaluating the simulated outcome. And also familiarize with simulation languages, random number generation of discrete events.			
Instructional Objectives	**Student Outcomes**			
At the end of the course, student will familiarize				
1. Basics of manufacturing systems.	a			
2. Techniques for generation of random numbers	a	e		k
3. Design and evaluation of simulation experiments	a	e		k
4. Simulation languages	a			k
5. Concepts and simulation of discrete events	a	e		k

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction to Manufacturing Systems	**8**			
1.	Basic concepts and problems concerning systems	1	C	1	2
2.	Systems design: Decision making procedures	1	C	1	2
3.	Structural, Transformational and procedural aspects of manufacturing	1	C	1	2
4.	Modes of production, Process systems for manufacturing	1	C	1	2
5.	Logistic systems, Material flow & technological information flow	2	C	1	2
6.	Management and information systems for manufacturing	1	C	1	2
7.	Managerial information flow in manufacturing systems	1	C	1	2
	Unit II: Manufacturing System Modeling and Simulation	**8**			
8.	Basic concepts of probability	1	C, D	1	1,3
9.	Types of models	1	C	1	1,3
10.	Selecting input probability distributions	1	C, D	1	1,3
11.	Introduction to system simulation	1	C	5	1,3
12.	Discrete and Continuous simulation	2	C	5	1,3
13.	Simulation models and procedures	1	C	5	1,3
14.	Simulation software and applications	1	C	5	1,3
	Unit III: Random Number Generation	**8**			
15.	Techniques for generating random numbers	1	C, D	2	1
16.	Tests for random numbers	2	D	2	1
17.	Properties of random numbers	1	C	2	1
18.	direct transformation for acceptance and rejection techniques	2	D	2	1
19.	Inverse Transform Techniques	2	D	2	1
	Unit IV: Evaluation of Simulation Experiments	**8**			
20.	Input modeling Data collection,	1	C	3	1
21.	Selecting input distributions with data	1	C	3	1
22.	parameter estimation	1	C	3	1
23.	goodness-of-fit tests	1	D	3	1
24.	Selecting input models without data	1	C	3	1
25.	variance reduction techniques	2	D	3	1
26.	experimental layout and validation	1	C, D	3	1
	Unit V: Simulation Software and Examples	**09**			
27.	Programming for discrete event system simulation in GPSS	2	C	4	4,5
28.	Simulation of Production systems	2	C	4	4,5
29.	Inventory systems	1	C	4	4,5
30.	Queuing systems	1	C	4	4,5
31.	project networks	1	C	4	4,5
32.	maintenance and replacement systems	1	C	4	4,5
33.	Investment Analysis	1	C	4	4,5
34.	Cycle test-I	1			
35.	Cycle test-II	2			
36.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Jerry Banks and John S Carson, Barry L Nelson, David M Nicol, "*Discrete event system simulation*", Prentice Hall, India, 2009.
2.	David Bedworth & James Bailey, " *Integrated production control system management, analysis & design"*, 2nd ed., John Wiley & Sons Ltd
	Reference Books/Other Reading Material
3.	Carrle A, "*Simulation of Manufacturing Systems*", John Wiley and Sons Inc., New York, 1988
4.	Gordon G, "*Systems Simulation*", Prentice Hall of India Limited, New Delhi, 1998.
5.	Narsingh Deo, "*System Simulation with Digital Computer*", Prentice Hall of India, New Delhi, 2001

Course nature				Theory			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE424E	**Automotive Quality System**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Elective	Manufacturing Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire the knowledge of quality concepts, tool and techniques in automotive industries. And also familiarizing the international quality systems and modern management systems for quality.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Familiarize the quality concepts	a				k
2.	Understand Quality Management system and standards	a	c	e		k
3.	Known the Application of management tools and techniques for process improvement	a		e	j	k
4.	Known Automotive TS16949 quality system practices	a			j	k

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Basic Concepts of Quality	**8**			
1.	Quality, classification of quality and services	1	C	1	1
2.	Quality systems overview	1	C	1	1
3.	Product Quality design	1	C	1	1
4.	Quality engineering in design of production processes	1	C	1	1
5.	Quality characteristics	1	C	1	1
6.	Quality , Reliability and Safety	1	C	1	1
	Quality engineering in production	1	C	1	1
8.	Quality engineering in service	1	C	1	1
	Unit II: Quality Management Systems	**8**			
9.	Quality Management – A conceptual Frame Work	1	C	2	1
10.	Dimensions of Quality	1	C	2	1
11.	Costs of Quality	1	C	2	1
12.	Quality System Standards	1	C	2	1
13.	ISO 9000 clauses and its interpretations	2	C	2	4
14.	ISO TS16949 clauses and interpretation	2	C	2	1
	Unit III: Modern Management Tools and Techniques	**8**			
15.	Introduction to Modern Management Techniques	1	C	3	2
16.	5s concepts	1	C	3	2
17.	Kaizen techniques	1	C	3	2
18.	Six sigma methodologies	1	C	3	2
19.	Quality circles	1	C	3	2
20.	Taguchi loss function	2	C	3	2
21.	POKE –YOKE Techniques	1	C	3	2
	Unit IV: ISO TS16949 Requirements	**7**			
22.	Advanced Product Quality Planning (APQP)	2	C	4	1,5
23.	Design Failure Mode Effects Analysis	2	C	4	1,5
24.	Process Failure Mode Effects Analysis	2	C	4	1,5
25.	Production Part Approval Process (PPAP)	1	C	4	1,5
	Unit V: Quality Tools and Measurement Systems Analysis	**10**			
26.	Concepts of SPC detection vs. prevention	1	C	4	4

27.	Data collection methods	1	C	4	3
28.	Statistical Tools	1	C, D	4	3
29.	Understanding of measurement systems	1	C	4	1
30.	Variable Gauge R&R	2	C, D	4	1
31.	Introduction to Hypothesis Testing	1	C	4	2
32.	ANOVA	1	C, D	4	2
33.	Correlation Analysis	1	C, D	4	2
34.	Single and Multiple Regression	1	C, D	4	2
35.	Cycle test-I	1			
36.	Cycle test-II	2			
37.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	David Hoyle, "*Automotive quality system Handbook*" , Butterworth – Heinemann ltd, second edition,oxford,2000
2.	William M Feld, "*Lean Manufacturing: Tools, Techniques and How to Use Them*" , APICS, 2001
	Reference Books/Other Reading Material
3.	Montgomery Douglas C, "*Introduction to Statistical Quality Control*", John Wiley and Sons, New Delhi, 2007.
4.	Logo Thetis N, "*Managing for Total Quality – From Deming to Taguchi and SPC*", Prentice Hall of India Private Limited, New Delhi, 1997
5.	"*Advanced product quality planning and control plan*" 2nd Edition ,Standards media (2008)

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Cycle test I**	**Cycle test II**	**Cycle Test III**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

Vehicle Technology

15AE331E	Auxiliary Vehicle Systems	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Elective	Vehicle Technology			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To familiarize the students with the fundamentals of auxiliary vehicle systems.

Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the vehicle motion control and stabilization system	a	c	h	k	
2.	Know the importance of Driver assistance, security and warning system	a	c	h	k	
3.	Gain the knowledge of Safety and comfort system	a	c	h	k	
4.	Understand the auxiliary systems of chassis.	a	c	h	k	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Vehicle Motion Control and Stabilization System	**8**			
1	Adaptive Cruise Control System	1	C	1	1, 2
2	Electronic Transmission Control System	2	C	1	1, 2
3	Antilock Braking System	1	C	1	1, 2
4	Traction Control System	1	C	1	1, 2
5	Electronic Stability Program	2	C	1	1, 2
6	Electronic Brake Force Distribution System	1	C	1	1, 2
	Unit II: Information, Security and Warning System	**8**			
7	Collision Warning System	1	C	2	1, 2
8	Onboard Diagnosis System	1	C	2	1, 2
9	Immobilizer, Anti Theft Alarm System	1	C	2	1, 2
10	Voice Warning System	1	C	2	1, 2
11	Keyless Entry System, Central Locking System	1	C	2	1, 2
12	Tire Pressure Monitoring System	1	C	2	1, 2
13	Lane Departure Warning System	1	C	2	1, 2
14	Blind Spot Detection, Navigation And Infotainment System	1	C	2	1, 2
	Unit III: Comfort Systems	**8**			
16	Heating, Ventilation And Air Conditioning Systems (HVAC)	1	C	3	1, 2
17	Electronic Outside Rear View Mirror (OVRM)	1	C	3	1, 2
18	Rain Sensing Wiper System	1	C	3	1, 2
19	Environment Information System	1	C	3	1, 2
20	Tilt Able Steering Wheel, Garage Door Opening System	1	C	3	1, 2
21	Automatic Climate Control	1	C	3	1, 2
22	Adaptive Head Light	1	C	3	1, 2
23	Night Vision Assist, Traffic Jam Assist	1	C	3	1, 2
	Unit IV: Chassis Auxiliary System	**9**			
25	Power Assisted Steering System	1	C	4	3
26	Regenerative Braking System	1	C	4	3
27	Servo Brake	1	C	4	3
28	Hand Brake	1	C	4	3
29	Engine Exhaust Brakes	1	C	4	3
30	Hydro Elastic Suspension System	1	C	4	3
31	Rubber Suspension	1	C	4	3
32	Pneumatic Suspension	1	C	4	3
33	Drive By Wire System	1	C	4	3
	Unit V : Safety System	**8**			
34	Automatic Seat Belt Fastening System	1	C	3	1, 2

35	Collapsible Steering Column, Child Lock System	1	C	3	1, 2
36	Air Bags Deployment System	1	C	3	1, 2
37	Bumper Design For Safety	1	C,D	3	1, 2
38	Frontal Object Detection, Rear Vehicle Object Detection System	1	C	3	1, 2
39	Hill Start Assist	1	C	3	1, 2
40	Rollover Prevention	1	C	3	1, 2
41	Emergency Brake Assist, Emergency Response	1	C	3	1, 2
42	Cycle test-I	1			
43	Cycle test-II	2			
44	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	William B. Ribbens, *"Understanding Automotive Electronics"*, 6th Edition, Newnes, 2003.
2.	Robert N Brady "*Automotive computers and Digital Instrumentation*". A Reston Book, Prentice Hill, Eagle Wood Cliffs, New Jersey, 1988.
3.	Dr. Kirpal Singh, *"Automobile Engineering*" Volume – 1, 12th Edition, Standard Publishers
	Reference Books/Other Reading Material
4.	BOSCH, *Automotive Handbook*, 6th Edition, Bentley publishers

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE332E	**Automotive NVH**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P	Departmental Elective	Vehicle Technology		
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	This course reviews the fundamental concepts of acoustics, noise propagation and vibrations. Focus is given to the theory and equipments pertaining to the measurement of automotive acoustics, sound quality and vibrations.

Instructional Objectives		**Student Outcomes**										
At the end of the course, student will be able to												
1.	Understand fundamentals of vibration theory and familiar with basics of vibrations and their mathematic models.	a	b			e						
2.	Equip themselves about the vibration control techniques.	a	b	c		e						
3.	Understand the fundamentals of noise.	a							h	i		
4.	Understand measuring instruments, techniques and metrics used for automotive NVH.	a									j	k
5.	Understand the various automotive noise sources and their control techniques	a									j	k

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Basics of Vibration Analysis	**8**			
1.	Basic Concepts, Formulating The Equations Of Motion, Free Undamped Vibrations.	1	C,D	1,2	1,6
2.	Free Damped Vibrations.	1	C,D	1,2	1

3.	Logarithmic Decrement, Forced Vibrations, Magnification Factor.	2	C,D	1,2	1
4.	Torsional System Characteristics, Single Disc And Two Disc	2	C,D	1,2	1
5.	Two Degree Of Freedom Systems Under Harmonic Force, Modal Analysis.	1	C,D	1,2	1
6.	Coordinate Coupling	1	C,D	1	2
	Unit II: Vibration Control Techniques	**8**			
7.	Transmissibility Ratio	1	C,D	1,2	1
8.	Vibration Isolation	1	C,D	1,2	1
9.	Tuned Viscous Dampers	2	C,D	2	1
10.	Unturned Viscous Dampers	2	C,D	1,2	2
11.	Damping Treatments, Free Layer Damping	1	C,D	1	2
12.	Constrained Layer Damping	1	C,D	1	2
	Unit III: Noise Fundamentals	**8**			
13.	Fundamentals Of Acoustics – General Sound Propagation – Structure Borne Sound & Air Borne Sound	1	C	3	2
14.	Plane Wave Propagation - Wave Equation, Specific Acoustic Impedance, Acoustic Intensity, Spherical Wave Propagation – Acoustic Near And Far Fields.	1	C,D	3	2
15.	The Decibel Scale, Relationship Among Sound Power, Sound Intensity And Sound Pressure Level.	2	C,D	3	2
16.	Summation Of Pure Tones.	1	C,D	3	2
17.	Decibel Addition, Subtraction And Averaging Matrix From Element Stiffness.	2	C,D	3	2
18.	Anatomy Of Human Ear, Mechanism Of Hearing.	1	C	3	2
	Unit IV: NVH Measurements	**8**			
19.	Vibration And Noise Standards – Pass/Drive By Noise-Test Site- Meteorological Condition-Constant Speed Test- Wide Open Throttle Test.	1	C,D	4	5,6
20.	Interior Noise Test- Standards – Test Track Condition – Vehicle Operating Condition –Steady Speed – Full Throttle Test –Stationery Test- Microphone Positions.	2	C,D	4	5,6
21.	Stationery Vehicle Test- Standards- Test Site- Preparation Of The Vehicle-Vehicle Operating Condition.	2	C,D	4	5,6
22.	NVH Measurement Tools And Techniques- Vibration And Noise Measurement Transducers.	2	C	4	5,6
23.	Advanced Acquisition Techniques.	1	C	4	5,6
	Unit V: Automotive Noise Sources and Control Techniques	**9**			
24.	Methods For Control Of Engine Noise-Control Measures-Mufflers, Transmission Noise- Control Methods.	2	C	5	3-6
25.	Intake And Exhaust Noise – Attenuation Of Intake And Exhaust Noise- Dissipative Silencers – Reactive Silencers – Resonators.	2	C	5	3-6
26.	Aerodynamic Noise, Its Sources And Control Methods.	1	C	5	3-6
27.	Tire Noise And Their Control Methods, Brake Noise.	1	C	5	3-6
28.	Noise Control Strategy, Noise Control At Source.	1	C	5	3-6
29.	Noise Control Along The Transmission Path	1	C	5	5,6
30.	Barriers, Enclosures, Resonators	1	C	5	5,6
31.	Cycle test-I	1			
32.	Cycle test-II	2			
33.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Singiresu S. Rao, "*Mechanical Vibrations*" 5th Edition, Pearson, September , 2010
2.	Ambekar, A. G., "*Mechanical Vibrations and Noise Engineering*", PrenticeHall of India, New Delhi, 2006.
	Reference Books/Other Reading Material
3.	Beranek, L. L. and Ver, I, L., "*Noise and Vibration Control Engineering –Principles and Application*", John Wiley & Sons, Inc, 1992.

4.	Beranek, Leo Leroy,"*Acoustic measurements*" 1949
5.	Manasi P. Joshi, "*Noise &Vibration Measurement Techniquesin Automotive NVH*" 2012
6.	Malcolm J. Crocker, *"Handbook Of Noise And Vibration Control"*John Wiley & Sons, Inc 2007

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE333E	**Two and Three Wheeler Technology**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	E	Professional Elective	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	This course imparts technical knowledge on the construction, working and maintenance of the aggregates/systems of two and three wheeler vehicles.

Instructional Objectives		**Student Outcomes**										
At the end of the course, student will be able to												
1.	Gain knowledge about the Engines employed for two and three wheelers.	a	b			e						
2.	Understand about the Chassis and its sub-systems.	a	b	c		e						
3.	Perceive about the functionality of Brakes and wheels.	a							h			
4.	Gain knowledge on specific Case studies of major Indian models.	a									j	k
5.	Gather information about Servicing, maintenance and trouble shooting of two and three wheelers.	a									j	k

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I : Power Plant	**8**			
1.	Two stroke and four stroke SI engines - merits and demerits	1	C,D	1	1-6
2.	Symmetrical and unsymmetrical port timing diagram, valve timing diagram.	1	D	1	1
3.	Types of scavenging processes – merits and demerits. Scavenging efficiency, scavenging pumps and rotary valve engine.	1	D	1	1
4.	Fuel system – carburetion, gasoline fuel injection systems. Lubrication systems.	2	C,D	1	1
5.	Ignition system – magneto coil spark ignition system – battery coil spark ignition system – electronic ignition system.	2	C,D	1	1
6.	Starting systems – kick starter and electrical systems.	1	C	1	2
	Unit II : Chassis and Sub Systems	**8**			
7.	Types of main frames.	1	C,D	2	1
8.	Drive from engine to rear wheel – chain drive – shaft drive	1	C,D	2	1
9.	Clutch – single plate – multiple plates – centrifugal clutch.	2	D	2	1
10.	Transmission (gear box) – gear controls.	2	C,D	2	2
11.	Suspension – for front wheels – for rear wheels – shock absorbers.	1	D	2	2
12.	Panel meters and controls on handle bar.	1	D	2	2
	Unit III : Brakes and Wheels	**8**			
13.	Braking systems	1	C	3	1,2
14.	Drum brakes and disc brakes	2	C,D	3	1,2
15.	Brake links layout – for front wheels – for rear wheels. Brake adjustment	1	C,D	3	1,2

16.	Wheels – spokes wheel – cast wheel – disc wheel	2	C,D	3	1,2
17.	Tires	1	D	3	1,2
18.	Tubes – vulcanizing.	1	C	3	1,5
	Unit IV: Servicing, Maintenance, Trouble Shooting and Case Study of Major Indian Models	**8**			
19.	Servicing and case study of major Indian models	2	C	4,5	6
20.	Maintenance and case study of major Indian models	3	C	4,5	6
21.	Trouble shooting and case study of major Indian models	3	C	4,5	6
	Unit V: Three Wheelers	**9**			
22.	Case study of Indian models	2	C	4,5	6
23.	Front engine auto rickshaws	2	C	4,5	6
24.	Rear engine auto rickshaws	2	C	4,5	6
25.	Pickup vans	1	C	4,5	6
26.	Delivery vans	1	C	4,5	6
27.	Trailers	1	C	4,5	6
28.	Cycle test-I	1			
29.	Cycle test-II	2			
30.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text books**
1.	K.K. Ramalingam., "*Two wheelers*", Scitech Publications (India) Pvt. Ltd., Chennai 2012.
2.	Irving, P.E., "*Motor cycle Engineering".*, Temple press Book, London, 1992.
	Reference Books/Other Reading Material
3.	"*The Motor cycle Manuals*"., Temple press Ltd., London 1990.
4.	Marshall Cavensih., "*Encyclopedia of Motor cycling*", 20 volumes New York and London 1989.
5.	Bryant, R.V., Vespa "*Maintenance and Repair service*".
6.	*Manufacturers manual of various vehicles*

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE334E	**Special Types of Vehicles**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To inculcate the students about various types of vehicles used for off road and Farm applications.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand different types of off road equipments.	a	j	k	
2.	Understand the various classifications of tractors and its applications.	a	j	k	
3.	Understand the concepts of Earth moving machines.	a	j	k	
4.	Gain knowledge about the fundamentals of construction Machines.	a	j	k	
5.	Understand the applications of shovels and ditchers.	a	j	k	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Off Road Equipments	**9**			
1.	Transport Equipment: Powered Equipment, Tractors And Trolleys, - Constructional Details, Applications.	2	C	1	1
2.	Trailers, Platform Lift Trucks, Fork Lift Trucks, Containers And Supports.- Constructional Details, Applications	2	C	1	1
3.	Hauling Equipment: Types Of Dump Trucks, On-High Way Vehicles, Off High Way Vehicles. - Constructional Details, Applications	2	C	1	1
4.	Hoisting Equipment: Jacks, Truck Mounted Crane, Crawler Crane, and Outriggers. - Constructional Details, Applications	3	C	1	1
	Unit II: Farm Equipments	**9**			
5.	Tractors In Earth Moving ,Applications Of Tractors, Rating Of Tractors	1	C	2	2
6.	Wheeled And Crawler Tractor - Constructional Details, Applications	2	C	2	2
7.	Recent Trends In Tractor Design	2	C	2	2
8.	Power Shift Transmission And Final Drive In Caterpillar Tractor. – Mechanism	2	C	2	2
9.	Motor Grader: Recent Trends, Control Mechanism Of A Caterpillar Motor Grader	2	C	2	2
	Unit III: Earth Moving Machines	**11**			
10.	Bulldozers, Cable And Hydraulic Dozers. Constructional Details, Applications	2	C	3	2
11.	Crawler Tractor, Running And Steering Gears. Constructional Details, Applications	2	C	3	2
12.	Dump Trucks And Dumpers Constructional Details, Applications	2	C	3	2
13.	Loaders: Single Bucket, Multi Bucket And Rotary Types Constructional Details, Applications	3	C	3	2
14.	Power And Capacity Of Earth Moving Machines Constructional Details, Applications	2	C	3	2
	Unit IV: Construction Machines	**7**			
15.	Scrapers: Self-Powered Scrapers. Constructional Details, Applications	1	C	4	2
16.	Graders: Elevating Graders. Constructional Details, Applications	2	C	4	2
17.	Bush Cutters, Stumpers. Constructional Details, Applications	2	C	4	2
18.	Dozer, Rippers. Constructional Details, Applications	2	C	4	2
	Unit V: Special Application Machines	**5**			
19.	Power Shovel - Constructional Details, Applications - Drag Lines	2	C	5	2
20.	Revolving And Stripper Shovels	1	C	5	2
21.	Capacity Of Shovels	1	C	5	2
22.	Ditchers - Constructional Details, Applications	1	C	5	2
23.	Cycle test-I	1			
24.	Cycle test-II	2			
25.	Surprise test	2			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Wang. J. T., "*Theory of Grand vehicles*", John Wiley & Sons, New York, 1987.
	References
2.	"*Off the Road Wheeled and Combined Traction Devices*"., - Ashgate Publishing Co. Ltd. 1998

Course nature				Theory			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE335E	**Vehicle Performance And Testing**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	**15AE303**						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To familiarize the students about vehicle testing and performance.						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand the vehicle performance and prediction	a				j	k
2.	Diagnose engine performance characteristics	a		f		j	k
3.	Understand the performance characteristics of transmission system	a		f		j	k
4.	Understands the operational performance of a vehicle	a				j	k
5.	Gain knowledge about real time vehicle testing	a	b	f		j	k

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Vehicle Performance Estimation and Prediction	8			
1.	Aerodynamic Drag, Methods Of Estimation Of Resistance To Motion.	1	C	1	1,5
2.	Power Requirement For Propulsion.	1	C	1	1, 5
3.	Power Plant Characteristics & Transmission Related Requirements.	1	C	1	1, 5
4.	Vehicle Controls And Arrangement Of Power Train.	1	C	1	1, 5
5.	Vehicle Acceleration, Maximum Speed, And Grade Ability.	1	C	1	1, 5
6.	Drive Systems Comparisons, Hill Climbing Characteristics.	1	C	1	1, 5
7.	Ride Characteristics On Different Road Surfaces.	1	C	1	1, 5
8.	Effect Of Pressure, Temperature And Humidity On Power Output.	1	C	1	1, 5
	Unit II: Engine Performance Diagnosis	**9**			
9.	Engine Leak Diagnosis.	1	C	2	2
10.	Engine Noise Diagnosis.	1	C	2	2
11.	Engine Exhaust, Oil Consumption And Temperature Tests.	1	C	2	2
12.	Cooling System Performance Diagnosis.	1	C	2	2
13.	Engine Power Balance Test And Compression Tests.	1	I	2	2
14.	Valve Timing And Clearance Tests.	1	C,D,I	2	2
15.	Intake And Exhaust System Performance.	1	C	2	2
16.	Turbo Charger Performance- Boost Pressure And Waste Gate.	1	C	2	2
17.	Ignition System- No Start Diagnosis And Scope Testing.	1	C,I	2	2
	Unit III: Vehicle Transmission and Control Systems Performance	**8**			
18.	Friction Clutches- Diagnosing Of Slippage, Drag, Binding And Vibration.	1	C	3	2
19.	Performance Of Automatic Transmission Systems.	1	C	3	2
20.	Performance Of Bands And Transmission Fluid.	1	C	3	2
21.	Electronically Shifted Transmission- Computer And Solenoid Valve Test, Driveline- Drive Shaft, U-Joint And Differential Diagnosis.	1	C	3	2
22.	Braking Arrangements, Braking Performance And Characteristics	1	C	3	2, 4

23.	Roll Center Analysis, Weight Transfer Effects, Steering Arrangement And Its Characteristics.	1	C	3	2, 4
24.	Performance And Characteristics Of Rigid & Independent Suspension.	1	C	3	2, 4
25.	Performance Characteristics Of Torsion Bar Stabilizer And Radius Bar.	1	C	3	2, 4
	Unit IV: Operational Performance	**8**			
26.	Engine Performance & Operating Characteristics.	1	C	4	4
27.	Operation At Full Load And Part Load Conditions.	1	C	4	4
28.	Fuel Economy.	1	C	4	4
29.	Effect Of Vehicle Condition.	1	C	4	4
30.	Tire And Road Condition	1	C	4	4
31.	Traffic Condition And Driving Habits On Fuel Economy.	2	C	4	4
32.	Vehicle Safety.	1	C	4	4
	Unit V: Vehicle Testing	**8**			
33.	Noise, Vibrations And Harshness.	1	C, I	5	4
34.	Testing Of Power & Fuel Consumption.	1	C,D, I	5	4
35.	Vehicle Testing On Chassis Dynamometers.	1	C, I	5	4
36.	Road And Track Testing.	1	C, I	5	4
37.	Initial Inspection, Running In, Durability And Extensive Driving.	1	C	5	4
38.	Maximum Speed & Acceleration.	1	C	5	4
39.	Brake Testing On The Road, Hill Climbing.	1	C, I	5	4
40.	Handling& Ride Characteristics On Different Road Surfaces, ride comport	1	C	5	4
41.	Cycle test-I	1			
42.	Cycle test-II	2			
43.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Martyr A. J, Plint M. A, "*Engine Testing Theory and Practice*", 3rd edition, Butterworth-Heinemann, 2007.
2.	Ken Pickerill, "*Automotive Engineering Engine Performance Shop Manual*", Cengage Learning, 2010
	Reference Books/Other Reading Material
3.	Gousha H. M, "*Engine Performance Diagnosis & Tune Up Shop Manual*".
4.	Crouse. W. H, Anglin. D. L, "*Motor Vehicle Inspection*", McGraw Hill, 1978.
5.	Giles J. G, "*Vehicle Operation & Performance*".

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage:	**50%**

15AE336E	**Advanced Vehicle Technology**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	PROFESSIONAL ELECTIVE	VEHICLE TECHNOLOGY				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To impart knowledge about the recent trends and developments in vehicle technologies.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand various trends in Automotive power plants	a		j	k
2.	Gain knowledge about various modern suspension and braking systems	a		j	k

3.	Understand various emissions and noise pollution control techniques	a		j	k
4.	Understand the fundamentals of modern sensors, actuators, ignition and injection systems	a		j	k
5.	Gain knowledge about Automated tracks for safe and fast travel	a		j	k

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Trends in Automotive Power Plants	**5**			
1.	Hybrid Vehicles – Stratified Charged / Lean Burn Engines Hydrogen Engines	2	C	1	1
2.	Battery Vehicles – Electric Propulsion With Cables	2	C	1	1
3.	Magnetic Track Vehicles.	1	C	1	1
	Unit II : Suspension Brakes and Safety	**8**			
4.	Interconnected Air And Liquid Suspensions	1	C	2	2,3
5.	Hydro Elastic Suspension System, Hydro Gas Suspension	1	C	2	2,3
6.	Closed Loop Suspension	1	C	2	2,3
7.	Modern Rear Wheel Brake	1	C	2	2,3
8.	Indirect Floating Caliper Disc Brake, Self Energizing Disc Brake	1	C	2	2,3
9.	Brake Limiting Device, Anti-Skid System, Regenerative Braking	2	C	2	2,3
10.	Passenger Comfort.	1	C	2	2
	Unit III :Emission And Noise Pollution Control	**8**			
11.	Engine Emissions, Types Of Catalytic Conversion	1	C	3	6
12.	Open Loop And Closed Loop Operation To The Oxidizing Catalytic Converter	2	C	3	6
13.	Evaporative Emissions	1	C	3	6
14.	Internal And External Noise, Identification Of Noise Sources	2	C	3	5
15.	Noise Control Techniques.	2	C	3	5
	Unit IV: Vehicle Operation and Control	**11**			
16.	Fundamentals of Automotive Electronics - sensors, actuators, Processors	2	C	4	2, 4
17.	Computer Control for pollution, noise and for fuel economy	3	C	4	6
18.	Electronic Fuel Injection	2	C	4	6
19.	Electronic Ignition system	2	C	4	6
20.	Transducers And Operation Of The Vehicle Like Optimum Speed And Direction.	2	C	4	6
	Unit V: Vehicle Automated Tracks	**9**			
21.	Preparation And Maintenance Of Proper Road Network	3	C	5	4
22.	National Highway Network With Automated Roads And Vehicles	3	C	5	4
23.	Satellite Control Of Vehicle Operation For Safe And Fast Travel	3	C	5	4
24.	Cycle test-I	1			
25.	Cycle test-II	2			
26.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	T. K. Garrett "*The Motor Vechicle*"., 13th edition 2009.
2.	Dr. N.K. Giri, "*Automobile Mechanic*", Khanna Publishers, 2006
3.	Heinz Heisler, "*Advanced vehicle technology*"., elsevier Store.2002
	References
4.	Crouse/Anglin "*Automotive Mechanics*" Career Education; 10th edition January 13, 1993
5.	Beranek. L.L. "*Noise Reduction*"., McGraw-Hill Book Co., Inc, Newyork, 1993
6.	*"Bosch Hand Book"*., 3rd Edition, SAE,1993

Course nature				Theory			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE431E	**Automotive Safety and Ergonomics**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To impart knowledge about the concept of automotive safety and comfort in an automobile.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand the basics of vehicle collision and its effects.	a	c	j	k
2.	Understand the various safety concepts used in passenger cars.	a	c	j	k
3.	Gain knowledge about various safety and its equipment.	a	c	j	k
4.	Understand the concepts of vehicle ergonomics.	a	c	j	k
5.	Gain knowledge about various automotive comforts features.	a	c	j	k

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction	**9**			
1.	Design Of The Body For Safety, Energy Equations, Engine Location	1	C, D	1	1
2.	Effects Of Deceleration Inside Passenger Compartment	1	C	1	1
3.	Deceleration On Impact With Stationary And Movable Obstacle	1	C	1	1
4.	Concept Of Crumble Zone And Safety Sandwich Construction	1	C	1	1
5.	Active And Passive Safety	1	C	1	1
6.	Characteristics Of Vehicle Structures	1	C	1	1
7.	Optimization Of Vehicle Structures For Crash Worthiness	1	C	1	1
8.	Types Of Crash / Roll Over Tests, Regulatory Requirements For Crash Testing	1	C	1	1
9.	Instrumentation, High Speed Photography, Image Analysis.	1	C	1	1
	Unit II: Safety Concepts	**8**			
10.	Active Safety- Driving Safety, Conditional Safety	1	C	2	1
11.	Perceptibility Safety, Operating Safety	1	C	2	1
12.	Passive Safety: Exterior Safety	1	C	2	1
13.	Interior Safety	1	C	2	1
14.	Deformation Behavior Of Vehicle Body	1	C	2	1
15.	Speed And Acceleration Characteristics Of Passenger Compartment On Impact	1	C	2	1
16.	Pedestrian Safety - Human Impact Tolerance- Determination Of Injury Thresholds	1	C	2	1
17.	Severity Index, Study Of Comparative Tolerance, Study Of Crash Dummies	1	C	2	1
	Unit III: Safety Equipments	**8**			
18.	Seat Belt, Automatic Seat Belt Fastening System,	1	C	3	4
19.	Collapsible Steering Column, Tiltable Steering Wheel	1	C	3	4
20.	Air Bags, Electronic Systems For Activating Air Bags	1	C	3	4
21.	Frontal Design For Safety, Collision Warning System	1	C	3	4
22.	Causes Of Rear End Collision, Frontal Object Detection, Rear Vehicle Object Detection System	1	C	3	4

23.	Object Detection System With Braking System Interactions.	1	C	3	4
24.	Anti-Lock Braking System.	1	C	3	4
25.	ESP And EBD Systems	1	C	3	4
	Unit IV: Vehicle Ergonomics	**8**			
26.	Introduction To Human Body - Anthropometrics And Its Application To Vehicle Ergonomics	1	C	4	2
27.	Cockpit Design	1	C	4	2
28.	Driver Comfort – Seating, Visibility	1	C	4	2
29.	Man-Machine System- Psychological Factors – Stress, Attention	1	C	4	2
30.	Passenger Comfort - Ingress And Egress, Spaciousness, ,	1	C	4	2
31.	Ventilation, Temperature Control	1	C	4	2
32.	Dust And Fume Prevention And Vibration, Interior Features And Conveniences	1	C	4	2
33.	Use Of Modern Technology For The Same	1	C	4	2
	Unit V: Comfort and Convenience System	**8**			
34.	Cabin Comfort - In-Car Air Conditioning – Overall Energy Efficiency	1	C	5	2
35.	Air Management, Central And Unitary Systems, Air Flow Circuits, Air Cleaning, Ventilation, Air Space Diffusion	1	C	5	2
36.	Compact Heat Exchanger Design, Controls And Instrumentation	1	C	5	2
37.	Steering And Mirror Adjustment, Central Locking System	1	C	5	2
38.	Garage Door Opening System, Tire Pressure Control System, Rain Sensor System, Environment Information System, Automotive Lamps, Types, Design, Construction, Performance	1	C	5	2
39.	Light Signaling Devices- Stop Lamp, Rear Position Lamp, Direction Indicator	1	C	5	5
40.	Reverse Lamp, Reflex Reflector, Position Lamp, Gas Discharge Lamp, LED	1	C	5	5
41.	Adoptive Front Lighting System (AFLS) And Daylight Running Lamps (DRL).	1	C	5	5
42.	Cycle test-I	1			
43.	Cycle test-II	2			
44.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Prasad, Priya and Belwafa Jamel, "*Vehicles Crashworthiness and Occupant Protection*", American Iron and Steel Institute, USA.
2.	JullianHappian-Smith "*An Introduction to Modern Vehicle Design*" SAE, 2002
	Reference Books/Other Reading Material
3.	Bosch - "*Automotive Handbook*" - 5th edition - SAE publication - 2000.
4.	"*Recent development in Automotive Safety Technology*", SAE International Publication. Editor: Daniel J Helt,2013.
5.	Keitz H.A.E. "Light Calculations and Measurements", Macmillan 1971.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage:		**50%**

15AE432E	Vehicle Maintenance			L	T	P	C
				3	0	0	3
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	This course provides the basic knowledge about various methods of maintaining different systems in Automobiles and provides various trouble shooting techniques.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Gain knowledge about vehicle operation and maintenance, service schedules etc.,	a		j	k
2.	Gain skills in handling situations where the vehicle is likely to fail.	a	j	k	
3.	Understand maintenance procedures like repairing, overhauling etc.,	a	j	k	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Maintenance of Workshop Records and Schedules	**8**			
1.	Importance Of Maintenance, Scheduled And Unscheduled Maintenance	1	C	1	1
2.	Requirements Of Maintenance, Preparation Of Check Lists	1	C	1	1
3.	Vehicle Down Time, Vehicle Inspection, Inspection Schedule	1	C	1	1
4.	Maintenance Of Records, Reports, Log Books, Trip Sheets And Other Forms	1	C	1	1
5.	Safety Precautions In Maintenance, Fleet Maintenance Requirement	1	C	1	1
6.	Work Shop Layout, Tools And Equipment	1	C	1	1
7.	Spare Parts And Lubricants Stocking, Manpower, Training	1	C	1	1
8.	Workshop Management, Warranty, Replacement Policy	1	C	1	1
	Unit II: Powertrain Maintenance	**8**			
9.	Dismantling Of Engine Components And Cleaning	1	C	3	2
10.	Cleaning Methods, Visual And Dimensional Inspections	1	C	3	2
11.	Minor And Major Reconditioning Of Various Components, Reconditioning Methods	1	C	2	2
12.	Engine Assembly, Special Tools Used For Maintenance And Overhauling, Engine Tune Up	1	C	3	2
13.	Servicing And Maintenance Of Automobile Clutch	1	C	3	3
14.	Servicing And Maintenance Of Gear Box	1	C	3	3
15.	Servicing And Maintenance Of Propeller Shaft And Differential System	1	C	3	3
16.	Trouble Shooting Checklist For Engine, Clutch And Gear Box.	1	C	2	2
	Unit III:Vehicle Chassis and Body Maintenance	**8**			
17.	Maintenance And Servicing Of Front Axle And Rear Axle	1	C	3	3
18.	Maintenance And Servicing Suspension And Braking Systems	1	C	3	3
19.	Steering Systems- Overhauling And Maintenance	1	C	3	2
20.	Wheel Alignment- Computerized Alignment And Wheel Balancing	1	C	3	2
21.	Troubleshooting Checklist For Front Axle And Rear Axle	1	C	2	3
22.	Troubleshooting Checklist For Suspension And Steering Systems	1	C	2	3
23.	Body Panel Tools For Repairing, Tinkering And Painting	1	C	3	2
	Unit IV: Electrical System Maintenance	**8**			

24.	Testing Methods For Checking Electrical Components	1	C	3	3
25.	Checking Battery And Starter Motor	1	C	3	3
26.	Checking Charging System, DC Generator	1	C	3	3
27.	Checking Alternator	1	C	3	3
28.	Checking Ignition Systems And Lighting Systems	1	C	3	3
29.	Fault Diagnosis And Maintenance Of Modern Electronic Controls	1	C	2	3
30.	Checking And Servicing Of Dash Board Instruments	1	C	3	3
31.	Trouble Shooting On Engine Management System, On Board Diagnosis Using Multi-Scanner	1	C	2	3
	Unit V: Maintenance of Auxiliary Systems	**9**			
32.	Servicing And Maintenance Of Fuel System Of Different Types Of Vehicles	1	C	3	3
33.	Calibration And Tuning Of Engine For Optimum Fuel Supply	1	C	3	3
34.	Cooling System Maintenance - Water Pump, Radiator, Thermostat, Anticorrosion And Antifreeze Additives	1	C	3	3
35.	Lubrication System Maintenance	1	C	3	3
36.	Lubricating Oil Changing,	1	C	3	3
37.	Greasing Of Parts	1	C	3	3
38.	Minor And Major Repairs Of Body Parts	1	C	3	3
39.	Maintenance Of Door Locking Mechanism	1	C	3	3
40.	Maintenance Of Window Glass Actuating System	1	C	3	3
41.	Cycle test-I	1			
42.	Cycle test-II	2			
43.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	John Doke, *"Fleet Management",* McGraw Hill Co. 1984.
	Reference Books/Other Reading Material
2.	James D Halderman, *"Advanced Engine Performance Diagnosis"*, PHI, 1998
3.	*"Service Manuals from Different Vehicle Manufacturers".*

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE433E	**Tyre Technology**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To provide the fundamental knowledge about the construction, performance and dynamic behavior of automotive tyres.

Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand various methods of tyre preparation	a				k	
2.	Gain knowledge about the forces and moments acting on tyres	a	b	c	e	k	
3.	Understand wear possibilities, their causes and measurements	a			e	k	
4.	Understand the safety of tyres and its failure analysis	a		c		k	
5.	Gain knowledge about the tyre testing methods	a				k	j

Session	**Description of Topic**	**Contact**	**C-D-I-O**	**IOs**	**Reference**

		hours			
	Unit I: An Overview of Tyre Technology	**8**			
1.	Introduction – Tyre Basic Function- Tire Types-Diagonal-Belted Bias- Radial Bias	1	C	1	1-5
2.	Tyre Components- Radial Tyre Components	1	C	1	1-5
3.	Radial Tyre Design Process	2	C	1	2
4.	Tyre Performance Criteria – Indoor Test And Outdoor Test	2	C	1	2
5.	Tyre Manufacturing- Compound Preparation- Calendaring- Tyre Assembly- Curing- Inspection- Quality Control Tests	2	C	1	2
	Unit II: Tyre Forces and Moments	**8**			
6.	Forces And Moments	1	C,D	2	2,3,5
7.	Rolling Resistance	1	C,D	2	2,3,5
8.	Cornering Properties- Slip Angle And Cornering Force	2	C,D	2	2,3,5
9.	Performance Of Tyre On Wet Surface	2	C	2	2
10.	Ride Properties Of Tyres	2	C,D	2	2
	Unit III: Rubber Abrasion and Tyre Wear	**8**			
11.	Sliding Abrasion	1	C	3	2
12.	Tyre Wear	1	C	3	2
13.	Influence Of Road Surface- Driving Influences	2	C	3	2
14.	Speed And Load Distributions	2	C	3	2
15.	Road Wear And Force Distribution	1	C,D	3	1,2
16.	Tire Construction	1	C	1	1-5
	Unit IV: Introduction to Tire Safety, Durability and Failure Analysis	**8**			
17.	Service- Maintenance Safety- On Vehicle- In-Service Safety	1	C	4	2
18.	Fundamentals Of Tyre Durability	1	C	4	2
19.	Nature Of Tyre Durability- Deflection, Heat, Speed, Tyre Structural Failures	2	C	4	2
20.	Common In-Service Tyre Failure Modes	1	C	4	2
21.	Run Low/ Flux Break- Tyre Tread Bead Detachment- Rapid Air Loss	1	C	4	2
22.	Over Deflection- Intra-Carcass Pressurization- Cuts And Punctures- Improper Repair- Improper Repair- Tyre Defects	2	C	4	2
	Unit V: Non-Destructive Tests and Inspections	**9**			
23.	Introduction Of Inspection Techniques	1	C	5	2
24.	X-Ray Examination	2	C	5	2
25.	Shearography	2	C	5	2
26.	Ultrasound	2	C	5	2
27.	Eddy Currents	2	C	5	2
28.	Cycle test-I	1			
29.	Cycle test-II	2			
30.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
S.No.	**Text Books**
1.	J. Y. Wong, "*Theory of Ground Vehicles"*, 4th Edition"2008
2.	US Department of Transportation., "*The Pneumatic Tire"*,February 2006
	Reference Books/Other Reading Material
3	Reza N. Jazar, "*Vehicle Dynamics: Theory and Application*" Springer 2008
4	Hans B. Pacejka, "*Tire and Vehicle Dynamics",* 3rd Edition, 2002
5	Rajesh Rajamani, "*Vehicle dynamics and control*", Springer Science & Business Media, 2006

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE434E	Automotive Standards and Regulations	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Elective	Vehicle Technology			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To familiarize the students about various automotive standards and regulations.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Gain knowledge about basic automobile standards and regulations.	a	h	j	
2.	Gain knowledge about standards for safety during collision.	a	h	j	
3.	Understand the various standards used for automotive electrical systems.	a	h	j	
4.	Gain knowledge about the regulations used for hybrid and electric vehicles.	a	h	j	
5.	Gain knowledge about the regulations used for gaseous fuel vehicles.	a	h	j	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: General Automotive Standards and Regulations	**9**	**C**	1	1
1.	Procedure For Type Approval And Certification Of Vehicles For Compliance To Central Motor Vehicles Rules.	1	**C**	1	1
2.	Speed Limitation Devices And Its Specifications.	1	**C**	1	1
3.	Arrangement Of Foot Controls Of Vehicles.	1	**C**	1	1
4.	Starting Grade-Ability - Method Of Measurement And Requirements.	1	**C**	1	1
5.	Protective Helmets For Motor Cycle Riders.	1	**C**	1	1
6.	Protective Helmets And Visors For Motorcycle Riders – Specification.	1	**C**	1	1
7.	Two Wheeled Vehicles – Location, Identification And Operation Of Controls, Tell-Tales And Indicators.	1	**C**	1	1
8.	Procedure For Type Approval And Establishing Conformity Of Production For Safety Critical Components.	1	**C**	1	1
9.	NCAP And BNVSAP Ratings, Requirements For School Buses.	1	**C**	1	1
	Unit II: Collision Safety Standards	**9**			
10.	Bumper Fitment On Vehicles – Test Methods.	1	**C**	2	1
11.	Safety Belt Assemblies, Safety Belt Anchorages – Specifications.	1	**C**	2	1
12.	Seats, Their Anchorages And Head Restraints Specifications, Survival Space For The Protection Of The Occupants.	1	**C**	2	1
13.	Requirements For Behavior Of Steering Mechanism Of A Vehicle In A Head-On Collision.	1	**C**	2	1
14.	Procedure For Determining The "H" Point And The Torso Angle In Seating Positions Of Motor Vehicles.	1	**C**	2	1
15.	Requirements For The Protection Of The Occupants In The Event Of An Offset Frontal Collision.	1	**C**	2	1
16.	Approval Of Vehicles With Regards To The Protection Of The Occupants In The Event Of A Lateral Collision.	1	**C**	2	1
17.	Requirements For The Protection Of Pedestrian And Other Vulnerable Road Users In The Event Of A Collision With A Motor Vehicle.	1	**C**	2	1
18.	Requirements For The Protection Of Fuel System In The Event Of Rear Impact Of A Motor Vehicle.	1	**C**	2	
	Unit III: Automotive electrical Standards	**9**			1
19.	Testing Procedure And Requirements For Headlamp Beam.	1	**C**	3	1
20.	Approval Of Front Position Lamps, Rear Position Lamps, Stop Lamps, Direction Indicators, Rear Registration Plate Illuminating Devices And Reversing Lamp.	1	**C**	3	1

21.	Provisions Concerning The Approval Of Headlamps Equipped With Gas Discharge Light Sources.	1	**C**	3	1
22.	Provisions Concerning The Approval Of Light Emitting Diode (LED) Light Sources For Use In Approved Lamp Units.	1	**C**	3	1
23.	Lighting, Signaling & Indicating Systems On Motor Vehicles.	1	**C**	3	1
24.	Performance Requirements Of Lighting And Light-Signaling Devices.	1	**C**	3	1
25.	Testing Standards For Wind Screen Wiping System.	1	**C**	3	1
26.	Horn Installation Requirement.	1	**C**	3	1
27.	Electronic Stability Control Systems.	1	**C**	3	1
	Unit IV: Electric and Hybrid Vehicle Standards	**9**			
28.	Battery Operated Vehicles – Requirements For Construction And Functional Safety.	1	**C**	4	1
29.	Measurement Of Electrical Energy Consumption.	1	**C**	4	1
30.	Method Of Measuring The Range.	1	**C**	4	1
31.	Measurement Of Net Power And The Maximum 30 Minute Power And Speed.	1	**C**	4	1
32.	Electric Power Train - Requirements For Construction And Functional Safety.	1	**C**	4	1
33.	Measurement Of Electrical Energy Consumption.	1	**C**	4	1
34.	Method Of Measuring The Range.	1	**C**	4	1
35.	Measurement Of Net Power And The Maximum 30 Minute Power And Speed.	1	**C**	4	1
36.	CMVR Type Approval For Hybrid Electric Vehicles, CMVR Type Approval Of Vehicles Retrofitted With Hybrid Electric System.	1	**C**	4	1
	Unit V: CNG, LPG Vehicles and Engine Emission Standards	**5**			
37.	Safety And Procedural Requirements For Type Approval Of CNG Operated Vehicles.	1	**C**	5	1
38.	Safety And Procedural Requirements For Type Approval Of LPG Operated Vehicles.	1	**C**	5	1
39.	Code Of Practice For Use Of LPG Fuel In Internal Combustion Engine To Power 4 Wheeled Vehicles.	1	**C**	5	1
40.	Code Of Practice For Use Of LPG Fuel In Internal Combustion Engine To Power 2 & 3 Wheeled Vehicles.	1	**C**	5	1
41.	Code Of Practice For Use Of CNG Fuel In Internal Combustion Engine Vehicles, Bharath And Euro Emission Norms.	1	**C**	5	1
42.	Cycle test-I	1			
43.	Cycle test-II	2			
44.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources

Sl. No.	**References / Class Materials**
1.	ARAI publications "*Automotive industry standards*", April 30, 2016.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage:	**50%**

15AE435E	**Motorsport Technology**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicle Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To impart knowledge about racing vehicle behavior and various technologies used in motorsports.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the fundamentals of racing vehicle characteristics.	a	e	j	k	
2.	Understand aerodynamic requirements in racing vehicles.	a	e	j	k	
3.	Understand the concepts of chassis behavior of racing vehicles.	a	e	j		
4.	Gain knowledge about the concepts of suspension characteristics of racing vehicles.	a	e	j	k	
5.	Understand the problems faced in drives and braking systems in motorsports.	a	e	j	k	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Race Car Design and Development	**8**			
1.	Problems Imposed By Racing, Racing Objective, "g-g" Diagram.	1	C	1	1, 2
2.	Constraints And Specifications – Performance, Handling, Structure.	1	C	1	1
3.	Driver Accommodation And Safety, Tires.	1	C	1	1
4.	Adjustable Features, Preliminary Design And Analysis.	1	C	1	1
5.	Driver-Vehicle Relationship.	1	C	1	1
6.	Desirable Vehicle Characteristics, Fundamentals Of Testing.	1	C	1	1
7.	Track Test Program Planning And Test Methodology.	1	C	1	1
8.	General Notes On Development – Circular Skid Pad Testing.	1	C	1	1
	Unit II: Race Car Aerodynamics	**8**			
9.	Aerodynamic Force And Moment, Race Car Drag Components, Drag Improvement And Estimation.	1	C	2	1, 2
10.	Ground Effects And Ground-Plane Simulation In Race Car Applications.	1	C	2	1
11.	Spoilers, Dams, Wings - Effectiveness Of Wings In Steady State Cornering.	1	C	2	1
12.	High Lift Devices- Flaps And Slats. Flow Control Devices- Dams, Fences, Vanes, Skirts, Spoilers.	1	C	2	1
13.	Vortex Creating Devices- Ledges, Edges, Cusps, Lips.	1	C	2	1
14.	Pressure Change Creation Devices- Perforations, Vents, Bleeds, Scoops, Seals.	1	C	2	1
15.	Air-Foil Devices- Slats, Flaps, End Plates, Cuffs, Fillets, Trips.	1	C	2	1
16.	Active Flow Control Devices- Internal Airflow, RAM Air Ducted Radiator, Air Entrance Scoop.	1	C	2	1
	Unit III: Race Car Chassis	**8**			
17.	Conditions For Traversing A 90° Corner, Principle Chassis Tuning Items.	1	C, D	3	1, 2
18.	Effects Of High Speed Braking, Cornering, Combined Braking Cornering.	1	C	3	1
19.	Steady State Cornering, Acceleration Out Of A Corner, Straight Line Acceleration.	1	C	3	1, 3
20.	Throttle Behaviour, Steering Wheel Force And Kick Back.	1	C	3	1
21.	Moving CG Position, Roll Center Position Changing Anti-Pitch Geometry.	1	C, D	3	1
22.	Chassis Steering Axis Geometry, Changing Camber.	1	C	3	1, 3
23.	Chassis Ride Roll Characteristics, Chassis Track Width.	1	C	3	1
24.	Chassis Ride Spring Rate, Tires And Rims, Adjusting Roll Stiffness And Roll Stiffness Distribution	1	C	3	1
	Unit IV: Race Car Suspension System	**8**			
25.	Front Suspension- General Design Issues, Camber Effects.	1	C, D	4	1
26.	SLA Suspension, McPherson Struts.	1	C	4	1
27.	Independent Rear Suspension- Trailing Arm Types, Instant Axis Concept.	1	C	4	1
28.	SLA Rear Suspension, Beam Axle Rear Suspensions.	1	C	4	1
29.	Torque Tube And Torque Arm Suspension, Decoupled Rear Axle Suspension.	1	C	4	1

30.	Suspension Springs- Torsion Springs, Coil Springs, Progressive Rate Coil Springs.	1	C	4	1
31.	Leaf Springs, Types, Installation Consideration, Inter Leaf Friction, Spring Fatigue.	1	C, D	4	1
32.	Damping In Racing- Ride/Handling Compromise, Steering Activity, And Transient Maneuvering, Bump Damping And Rebound Damping.	1	C, D	4	1
	Unit V: Race Cardrives And Braking Systems	**9**			
33.	Merits Of Front, Rear And Four-Wheel Drive In Racing.	1	C	5	1, 2
34.	Differentials Used In Racing- Open Differentials, Locked (Spool), Limited Slip Differentials.	1	C	5	1
35.	Traction Control And Other Electronic Improvements In Racing.	1	C	5	1, 2
36.	Mechanical Components In Braking System.	1	C	5	1
37.	Limitations And Considerations Of Braking In Racing.	1	C	5	1
38.	Brake Boost, Effects Of "g" Force On Brake Fluids.	1	C	5	1
39.	Brake Hydraulics, Ventilation.	1	C	5	1
40.	Brake Distribution, ABS In Racing.	1	C	5	1
41.	Carbon-Carbon discs.	1	C	5	2
42.	Cycle test-I	1			
43.	Cycle test-II	2			
44.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	William F.Milliken and Douglas L.Milliken, *"Race car vehicle dynamics"*, 11th edition, SAE, 1995.
2.	Peter Wright, *"Formula 1Technology",*2001.
	Reference Books/Other Reading Material
3.	Thomas D. Gillespie, "*Fundamental of Vehicle Dynamics, Society of Automotive Engineers*", USA 1992.
4.	Wolf-Heinrich Hucho, "*Aerodynamics of road vehicles*", 4th edition, 2000.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage:		**50%**

Design

15AE341E	Automotive Driveline Design	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	PSG Design Data Book				
Course Category	P Professional Elective	Design Engineering			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To acquire analytical ability in solving mathematical problems related to designing of automotive drive line components.

Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Learn the fundamental approach for designing.	a		e			
2.	Identify, formulate and solve engineering problems related to automobile drive line components.	a	c	e	f		
3.	Learn about the performances of various axles and to design the same.	a	c	e			
4.	Learn and design various braking systems.	a	c	e	f		
5.	Learn and design the various suspension systems.	a	c	e	f		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Statistical Consideration in Design and Optimization	**8**			
1	Ergonomics And Aesthetic Design, Statistics In Design, Design For Natural Tolerances, Statistical Analysis, And Mechanical Reliability.	1	C	1	1,6
2	Introduction To Design Optimization Of Mechanical Elements, Adequate & Optimum Design, Methods Of Optimization, Johnson's Method Of Optimum Design.	3	C	1	1,6
3	Simple Problems In Optimum Design Like Axially Loaded Members, Shaft Subjected To Tensional And Bending Moments And Other Machine Elements.	4	C,D	1-2	1,6
	Unit II: Design of Clutches and Gearbox	**8**			
4	Design Requirements Of Friction Clutches, Selection Criterion, Torque Transmission Capacity, Lining Materials.	3	D	1,2	1,4
5	Design Of Single Plate Clutch, Multi-Plate Clutch And Centrifugal Clutch.	1	D	1,2	1,4
6	Selection Of Gear Ratios & Final Drive Ratio, Design Of Gears, Shafts, Splines And Housing, Selection Of Bearings.	4	D	1,2	1,4
	Unit III:Design of Propeller Shafts and Axles	**8**			
7	Design Of Propeller Shafts For Bending, Torsion & Rigidity.	3	C,D	1,3	2
8	Design Of Universal Joints And Slip Joints, Final Drive.	1	C,D	1,3	2
9	Design Of Front & Rear Axles.	4	C,D	1,3	2
	Unit IV: Brake Systems	**8**			
10	Design Of Hydraulic Braking System.	1	C,D	1,4	4,5
11	Design Of Internal Expanding Shoe Brake And Disc Brake.	3	C,D	1,4	4,5
12	Design Of Master Cylinder, Drum Cylinder And Piping Design.	4	C,D	1,4	4,5
	Unit V: Design of Suspension and Steering System	**09**			
13	General Design Considerations Of Suspension System.	1	C,D	1,5	1
14	Design Of Leaf Springs For Automobile Suspension System.	4	C,D	1,5	1
15	Design Considerations Of Belleville Springs, Elastomeric Springs, Air(Pneumatic) Springs	2	C,D	1,5	1
16	Design Considerations Of Steering System And Vehicle Frame.	2	C,D	1,5	1
17	Cycle test-I	1			
18	Cycle test-II	2			
19	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1	Gian Carlo Genta, Lorenzo lorello "*The Automotive Chassis system design*" published by Springer.
2	Bhandari. V. B., "*Design of Machine Elements*", Tata McGraw-Hill Publishing Company Ltd, 2010.
	Reference Books/Other Reading Material
3	Joseph E. Shigley & Larry D. Mitchell, "*Mechanical Engineering Design*", 5 th Edition, McGraw-Hill International Book Company, 2002.
4	Patil S.P., "*Mechanical System Design*", 2nd edition, Jaico Publishers, 2005.
5	Spotts. M. F., Shoup. T. E., "*Design of Machine Elements*", 7 th Edition, Pearson Education, 1998.
6	Julian Hapian Smith, "*An Introduction to Modern Vehicle Design*", Society of Automotive Engineers Inc, 2002.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE342E	**Design for Safety and Comfort**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Design Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To provide an understanding to the engineering principles and design of an automobile for safety and comfort.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the design of automotive body and safety	a	c	e		k
2.	Understand the vehicle structure and crash energy management	a	c	e		k
3.	Gain knowledge about automotive safety systems	a	c	e		k
4.	Understand the convenience systems	a	c	e	j	k
5.	Understand the comfort systems	a	c	e	j	k

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Design of Automotive Body and Safety	**9**			
1.	Introduction To Automotive Safety Systems	1	C	1	1,7
2.	Design Of The Body For Safety And Engine Location	1	C,D	1	1,5,7
3.	Fatigue Failure Analysis For Vehicle Structure	1	C,D	1	1,5,7
4.	Design Of Crumble Zone	1	C,D	1	1,5,7
5.	Safety Sandwich Construction	1	C,D	1	5,7
6.	The Role Of Material Science In Design For Vehicle Safety.	1	C,D	1	5,7
7.	Material Selection For Design For Safety	2	C	1	5,7
8.	Crashworthiness And Its Requirements	1	C	1,2	5
	Unit II: Design of Vehicle Structures for Crash Energy Management	**9**			
9.	Crashworthiness-Tests	1	C,D	1,2	5
10.	Component And Sled Test	1	C	1	5
11.	Full-Scale Barrier Impact Test	2	C	1	5
12.	Crash/Crush Design Techniques For Front Structures	1	C,D	1,2	5,7
13.	Design Of Substructures	1	C,D	5	5, 7

14.	Vehicle Front Structure Design For Different Impact Modes	2	C,D	5	5,7
15.	Vehicle-To-Vehicle Frontal Collisions	1	C,D	5	5, 7
	Unit III: Design of Safety Systems	**7**			
16.	Design Of Seat Belt, Automatic Seat Belt Tightening System	1	C	2	3
17.	Collapsible, Tilt-Able Steering System Design	2	C	2,3	3
18.	The Design, Construction Of Air Bags	2	C,D	2,3	3
19.	Design Of Bumpers And Impact Bars For Safety	2	C,D	1-3	3
	Unit IV: Convenience System	**7**			
20.	Antiskid Braking System	1	C	1,3	2,4
21.	Traction Control System	1	C,D	1,3	2,4
22.	Adaptive Cruise Control	1	C	3	2,6
23.	Driving Assistance System- Electronic All Around Visibility	1	C	3	2,4,6
24.	Parking Aid With Ultrasonic Sensors	1	C,D	3	2,4,6
25.	Environment Information System	1	C	3	2,3
26.	Driver Alertness Detection System	1	C	3	2,3
	Unit V: Comfort Systems	**9**			
27.	NVH (noise, vibration and harshness) of chassis and optimization	2	C,D	3	3
28.	NVH of Engine	1	C,D	3	3
29.	NVH of power train.	1	C,D	3	3
30.	Ride Quality And Sound Quality.	1	C,D	3	3
31.	Heating, Ventilation And Air Conditioning Systems.	2	C,D	3	3
32.	Design Of An Active Suspension System	2	C,D	3	2,3,6
33.	Cycle test-I	1			
34.	Cycle test-II	2			
35.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Reference Books/Other Reading Material**
1.	Vivek D. "*Ergonomics in the Automotive Design Process*" Bhise publisher CRC press, Taylor and Francis group.
2.	Ronald K Jurgen, "*Automotive Electronics Handbook*" – 2nd edition- McGraw-Hill Inc., - 1999.
3.	Bosch, "*Automotive Handbook*", 5th edition - SAE Publication – 2000
4.	JullianHappian, "*Smith An Introduction to Modern Vehicle Design*", SAE, 2002.
5.	Johnson W and Mamalis A.G, "*Crashworthiness of Vehicles*", MEP, London.
6.	Richard Bishop, "*Intelligent Vehicle Technology and Trends*" – 2005
7.	George A. Peters , Barbara J. Peters, "*Automotive Vehicle Safety*" – 2002

Course nature	**Theory**

Assessment Method (Weightage 100%)

In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE343E	**Design for Race Cars**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE301						
Data Book / Codes/Standards	Approved Design Data Book						
Course Category	E	Professional Electives	Design Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire an introductory knowledge and ability in solving mathematical problems related to designing of race car vehicles and to understand their dynamic behaviors.

Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Know the fundamental requirement for designing of race cars.	e			f	j	
2.	Understand the aerodynamic behavior of race cars.	a	d	e	f		k
3.	Choose the most optimized engine for race cars.	a		e	f		
4.	Identify, formulate and solve engineering problems related to design of race cars.	a		e	f		k
5.	Learn the tire dynamics.	a		e	f		k

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Introduction to Race Car Design	**7**			
1.	Constraints And Specifications	3	C	1	1
2.	Design Process	4	C	1	1
	Unit II: Aerodynamic Fundamentals	**9**			
3.	Discussions On Bernoulli's Equations	3	C,D	1,2	1
4.	Pressure Distribution	3	C,D	1,2	1
5.	Aerodynamic Testing	3	C,D	1,2	1
	Unit III: Engine Dynamics	**8**			
6.	Engine Configurations, Engine Characteristics	3	C,D	3	3
7.	Carburetion & Fuel Injection.	3	C,D	3	3
8.	Minimum Torque Required For Moving The Vehicle.	2	C,D	3	3
	Unit IV: Introduction to Race Car Chassis	**8**			
9.	Types Of Chassis, Chassis Set-Up.	1	C,D	1,4	1
10.	Material Selection For Chassis.	2	C,D	1,4	1
11.	Strength To Weight Ratio Calculations.	2	C,D	1,4	1
12.	Design Aspects Of Different Compartments.	3	C,D	1,4	1
	Unit V: Introduction to Tire Dynamics	**9**			
13.	Wheel Loads	1	C	1,5	2
14.	Tire Construction	1	C	1,5	2
15.	Mechanics Of Force Generation	1	C	1,5	2
16.	Tractive Properties	1	C	1,5	2
17.	Cornering Properties	1	C	1,5	2
18.	Camber Thrust	1	C	1,5	2
19.	Aligning Moment	1	C	1,5	2
20.	Combined Braking And Cornering	1	C,D	1,5	2
21.	Tire Vibrations	1	C	1,5	2
22.	Cycle test-I	1			
23.	Cycle test-II	2			
24.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources

Sl. No.	**Text Books**
1.	William F.Milliken and Douglas L.Milliken, "*Race Car Vehicle Dynamics*", SAE Inc.
	Reference Books/Other Reading Material
2.	Thomas D.Gillespie , "*Fundamentals of Vehicle Dynamics*", SAE Inc.
3.	M.L Mathur and R.P.Sharma, "*A Course in Internal Combustion Engines*", Dhanpat Rai Publications.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE344E	New Product Development			L	T	P	C
				3	0	0	3
Co-requisite:	NIL						
Prerequisite:	15AE301						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Design Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	The objective of the course is to impart knowledge on the strategies, processes and methods used for new-product development.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Understand the principles involved in creativity, evaluation techniques.	a	c	h	
2.	Understand the innovation and to form new product Development.	a	c	h	
3.	Understand the new product planning.	a	c	h	
4.	Gain the knowledge about product development.	a	c	h	
5.	Understand the Product Architecture.	a	c	h	

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	References
	Unit I: Project Selection and Evaluation	**8**			
1.	Collection Of Ideas And Purpose Of Project	2	C	1	1,2,3
2.	Selection Criteria	3	C	1	1,2,3
3.	Screening Ideas For New Products (Evaluation Techniques).	3	C	1	1,2,3
	Unit II: New Product Development	**8**			
4.	Research And New Product Development	2	C	2	1,2,3
5.	Patents - Patent Search - Patent Laws	3	C	2	1,2,3
6.	International Code For Patents - Intellectual Property Rights (IPR)	3	C	2	1,2,3
	Unit III: New Product Planningn	**8**			
7.	Design Of Prototype – Testing	2	C	3	1,2,3
8.	Quality Standards	3	C	3	1,2,3
9.	Marketing Research - Introducing New Products	3	C	3	1,2,3
	Unit IV: New Product Development	**8**			
10.	Journeys In Product Development	1	C	4	1,2,3
11.	Product Development Process Tools	2	C	4	1,2,3
12.	Scoping Product Developments	2	C	4	1,2,3
13.	Technical And Business Concerns	1	C	4	1,2,3
14.	Understanding Customer Needs, Establishing Product Function	2	C	4	1,2,3
	Unit V:Product Architecture	**9**			
15.	Product Teardown And Experimentation	3	C	5	1,2,3
16.	Benchmarking And Establishing	3	C	5	1,2,3
17.	Engineering Specifications, Product Architecture	3	C	5	1,2,3
18.	Cycle test-I	1			
19.	Cycle test-II	2			
20.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Paul trott "*Innovation Management and New Product Development*" 5th Edition Sep 2011, Paperback, 648 pages, ISBN13: 9780273736561, ISBN10: 0273736566
2.	Barclay, Z. Dann, P. Holroyd, "*New Product development"* I, Published by BH Butterworth-Heinemann a division of Reed Educational and professional publishing limited.2000
	Reference Books/Other Reading Material
3	Harry Nystrom, "*Creativity and innovation*", John Wiley & Sons, 1979
4	Brain Twiss, "*Managing technological innovation*", Pitman Publishing Ltd., 1992.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE345E	**Automotive Chassis Component Design**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE301						
Data Book / Codes/Standards	PSG Design Data Book						
Course Category	P	Professional Elective	Design Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

PURPOSE	To enrich the student with in- depth of knowledge for automotive chassis and design aspects of automotive chassis components.

Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1	Understand the historical evolution of chassis, structures, wheels and mechanisms is involved in the domain of automotive chassis.	a	c	f	h	j	
2	Gain knowledge about various vehicular structures.	a	c	f	h	j	
3	Gain knowledge about various chassis structures and their testing methods.	a	c	f	h	j	
4	Understand the different types of suspension and its functions.	a	c	f	h	j	
5	Understand the transferring engine torque to drive axles.	a	c	f	h	j	

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Historical Evolution of Chassis, Structures, Wheels And Mechanisms	**6**			
1	Introduction, Rigid Axle Mechanical Linkages	1	C	1-5	1
2	Independent suspension mechanical linkages	2	C,D	1-5	1
3	Wheel And Tires	1	C,D	1	1
4	Brakes and Chassis Frames	2	C,D	1	1
	Unit II: Vehicle Structures	**11**			
5	Integral Body Structure		C	1,3	2
6	Engine, Transmission and Body Structure Mountings	2	C	1,3	2
7	Fifth Wheel Coupling Assembly	2	C	1,3	2
8	Trailer and Caravan Drawbar Couplings	2	C	1,3	2
9	Semi-Trailer Landing Gear	2	C	1,3	2
10	Automatic Chassis Lubrication System	2	C	1,3	2
	Unit III: Chassis Structures	**8**			
11	Underbody	2	C,D	1	1,3
12	Sub frame	2	C,D	1	1,3
13	Industrial Vehicle Frame	1	C,D	1	1,3
14	Structural Tasks	1	C,D	1	1,3

15	Structural Design	1	C,D	1	1,3
16	Structural Testing	1	C,D	1	1,3
	Unit IV: Suspensions	**8**			
17	Introduction, Independent Suspensions	2	C	4	1
18	Semi-Independent Suspensions	2	C	4	1
19	Rigid Axle Suspensions	1	C	4	1
20	Industrial Vehicle Suspensions	1	C	4	1
21	Design and Testing	2	C,D	4	1
	Unit V: Shafts and Joints	**8**			
22	Propeller Shafts	2	C	5	1,4
23	Half Shafts	2	C	5	1,4
24	Universal Joints	2	C	5	1,4
25	Constant Speed Joints	2	C	5	1,4
26	Cycle test-I	1			
27	Cycle test-II	2			
28	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1	Giancarlo Genta, Lorenzo Morello, "*The Automotive Chassis Volume 1, Components Design*", Springer International Edition.2014
2	Heinz Heisler, "*Advanced Vehicle Technology*", Butterworth Heinemann Publications. 2nd Edition 2002.
	Reference Books/Other Reading Material
3	Heldt, P.M., "*Automotive Chassis*", Chilton Book Co., 1992
4	Dean Averns, "*Automobile Chassis Design*", Illife Book Co., 2001

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE441E	**Vehicle Design Data Characteristics**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	**15AE301**						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Design Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire basic knowledge of the preliminary design concepts involved in designing of a vehicle.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1	Understand the basic design principle of vehicle & to be able to draw the performance curves pertain to engine and chassis	a	c	e	f	h
2	Equip themselves familiar with functions of several variables pertaining to vehicular design.	a	c	e	f	h

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction to Basic Concepts in Vehicular Design	**8**			
1	Assumptions To Be Made In Designing A Vehicle	2	C	1	1
2	Range Of Values For Gross Vehicle Weight	2	C,D	1	1
3	Range Of Values For Frontal Area, Maximum Speed, Maximum Acceleration	2	C,D	1	1
4	Gradability In Different Gears, Basics Of Automobile Design	2	C,D	1	1
	Unit II: Resistance to Vehicle Motion	**8**			
5	Calculation, Tabulation And Plotting Of Curves For Air And Rolling Resistances At Various Vehicle Speeds	2	D	1,2	1,3
6	Calculation And Plotting Of Driving Force	2	D	1,2	1,3
7	Power Requirement For Different Loads And Acceleration	2	D	1,2	1,3
8	Maximum Power Calculation	2	D	1,2	1,3
	Unit III: Performance Curves – I	**8**			
9	Calculation, Tabulation And Plotting Of Torque And Mechanical Efficiency For Different Vehicle Speeds	2	D	1,2	2
10	Interpolation Of Pressure-Volume Diagram	2	C,D	1,2	2
11	Calculation Of Frictional Mean Effective Pressure	2	D	1,2	2
12	Calculation Of Engine Cubic Capacity	1	D	1,2	2
13	Calculation Of Bore And Stroke Length	1	D	1,2	2
	Unit IV: Performance Curves – II	**8**			
14	Connecting Rod Length To Crank Radius Ratio, Plotting Of Piston Velocity And Acceleration Against Crank Angle	3	D	1,2	1,3
15	Plotting Gas Force, Inertia Force And Resultant Force Against Crank Angle	4	D	1,2	1,3
16	Turning Moment And Side Thrust Against Crank Angle	1	D	1,2	1,3
	Unit V: Gear Ratios	**9**			
17	Determination Of Gear Ratios	1	D	1,2	1,3
18	Determination Of Acceleration And Gradability	4	D	1,2	1,3
19	Typical Problems On Vehicle Performance	4	C,D	1,2	1,3
20	Cycle test-I	1			
21	Cycle test-II	2			
22	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1	Giri. N. K., "*Automotive Mechanics*", Khanna Publishers, New Delhi, 2005.
2	Heldt, P.M., "*High Speed Combustion Engines*", Oxford and I.B.H. Publishing Co., Kolkata, 2002.
	Reference Books/Other Reading Material
3	Gupta. R.B., "*Automobile Engineering*", Sathya Prakashan, 8 edu., 2013

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE442E	**Finite Element Analysis**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	**15ME203, 15ME204**						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional –Elective	Design Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

PURPOSE	To predict how a product reacts to real-world forces, vibration, heat, fluid flow, and other physical effects

Instructional Objectives		Student Outcomes					
At the end of the course, student will be able to							
1.	Apply finite element technique to Engineering problems	a	b	d	e	k	
2.	Improve their ability in solving differential equations for real world problems	a	b	d	e	k	
3.	Equip themselves familiar with multi-domain phenomenon like thermo-structural problems	a	b	d	e	k	
4.	Familiarize themselves with the applications of finite element method & FEA packages	a	b	e	k		
5.	Understand the concept of multibody dynamics	a	b	e	k		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Basic Concepts Of Fea	**8**			
1.	Brief History Of FEA &Comparison Of FEA With Exact Solutions	1	C	1-4	1,5
2.	General Procedure For FEA& Its Limitations	3	C	1	1,3,4,5
3.	Applications Of FEA	2	C	3,4	1
4.	Variational Approach – Rayleigh Ritz Method	2	C,D	2	1,3,4,5
5.	**Unit II: One Dimensional Problems**	**8**			
6.	Co-Ordinates – Global, Local And Natural &Shape Function	1	C	2	1,5
7.	Generation & Assembly Of Stiffness Matrix And Force Vector	2	C	2	1,5
8.	Imposing Of Boundary Conditions	1	D	2	1,5
9.	Applications To Spring, Bar, Beam And Truss Problems	4	D	2	1,3,4,5
10.	**Unit III: Higher Order Formulations**	**8**			
11.	Plane Stress And Plane Strain	1	C	2	1,5
12.	CST And LST Elements	2	C	2	1,5
13.	Axi-Symmetric &Iso-Parametric Formulations	2	C	2	1,3,5
14.	Four Node Quadrilateral Element	2	C	2	1,5
15.	Numerical Integration – Gaussian Quadrature	1	C	2	1,5
16.	**Unit IV: Standard Fea Packages**	**8**			
17.	Commercially Available FEA Packages	2	C,D	3,4	1,5
18.	Structure Of A Finite Element Analysis Program	3	D	4	5
19.	Pre And Post Processors Desirable Features Of FEA Packages	3	D	4	1,5
20.	**Unit V: Introduction to Multibody Systems**	**9**			
21.	Multibody Systems – Kinematic And Force Analysis	3	C	5	2
22.	Constrained Kinematics – Formulation Of Joint Constraints	3	C	2,5	2
23.	Application Of MBD Technique To Four-Bar And Slider Crank Mechanisms	3	C, D	2,5	2
24.	Cycle test-I				
25.	Cycle test-II				
26.	Surprise test				
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	David V. Hutton, "*Fundamentals of Finite Element Analysis*", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2005
2.	Ahmed A Shabana., "*Computational Dynamics* ", Wiley & Sons.
	Reference Books/Other Reading Material
3.	Seshu P., "*Text Book of Finite Element Analysis*", PHI Learning Private Limited, New Delhi, 2010
4.	Ramamurthy V., "*Finite Element Method in Machine Design*", Narosa Publishing House, New Delhi, 2009.
5.	Bhavikatti S.S., "*Finite Element Analysis*", New Age International Publishers, New Delhi, 2008.
6.	ErdoganMadenci, Ibrahim Guven, "*the finite element method and applications in engineering using ansys*", Springer (India) Private Limited, New Delhi, 2011.

Course nature				Theory			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE443E	**Concepts of Engineering Design**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Design Engineering				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

PURPOSE	To introduce the concepts of design processes, tools used in design methods, and knowledge on material selection, reliability and understanding of DFM/DFA , Legal and ethical issues in design and quality engineering.

Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able to								
1.	Gain knowledge on design processes	a						
2.	Explore software tools used in Design Methods		b		e			
3.	Understand the process of material selection and design		b			g		
4.	Gain knowledge on Engineering statistics and reliability in design			c	e			
5.	Understand the legal and ethical issues in Designing and Quality Engineering	a	c				j	k

Session	**Description of Topic (Theory)**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Design Process	**8**			
1	The Design Process – Morphology Of Design – Design Drawings	1	C	1	2,3
2	Computer Aided Engineering – Designing Of Standards – Concurrent Engineering	1	C	1	2,3
3	Product Life Cycle – Technological Forecasting	1	C	1	2,3
4	Market Identification– Competition Bench Marking	2	C	1	2,3
5	Systems Engineering – Life Cycle Engineering	2	C	1	2,3,5
6	Human Factors In Design – Industrial Design.	1	C	1	2,3,4
	Unit II: Design Methods	**8**			
7	Creativity And Problem Solving – Product Design Specifications– Conceptual Design	1	C,D	2	2,3
8	Decision Theory – Decision Tree – Embodiment Design	1	C	2	2,3
9	Detail Design – Mathematical Modeling – Simulation – Geometric Modeling	2	C,D	2	2,3
10	Finite Element Modeling – Optimization – Search Methods	2	C,D	2	2,3
11	Geometric Programming – Structural And Shape Optimization.	2	C,D	2	2,3
	Unit III: Material Selection Processing and Design	**8**			
12	Material Selection Process – Economics – Cost Vs Performance	1	C	3	1,4,5
13	Weighted Property Index – Value Analysis – Role Of Processing In Design	1	C,D	3	1,4,5
14	Classification Of Manufacturing Process	1	C	3	1,4,5
15	Design For Manufacture – Design For Assembly	2	C	3	1,4,5
16	Designing For Castings, Forging, Metal Forming, Machining And Welding	2	C	3	1,4,5
17	Residual Stresses – Fatigue, Fracture And Failure.	1	C,D	3	1,4,5
	Unit IV: Engineering Statistics and Reliability	**8**			
18	Introduction - Probability – Distributions	3	C,D	4	1,2,4
19	Test Of Hypothesis – Design Of Experiments	2	C	4	1,2,4

20	Reliability Theory – Design For Reliability	2	C	4	1,2,4
21	Reliability Centered Maintenance.	1	C	4	1,2,4
	Unit V:Legal and Ethical Issues in Design and Quality Engineering	**9**			
22	Introduction – The Origin Of Laws – Contracts – Liability	2	C	5	2,4,5
23	Tort Law – Product Liability – Protecting Intellectual Property	2	C	5	2,5
24	Legal And Ethical Domains – Codes Of Ethics - Solving Ethical Conflicts– Case Studies	2	C	5	2,4,5
25	Total Quality Concept – Quality Assurance – Statistics Process Control	1	C	5	2,3,5
26	Taguchi Methods – Robust Design – Failure Model Effect Analysis.	2	C,D	5	2,3,5
27	Cycle test-I	1			
28	Cycle test-II	2			
29	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Dieter, George E., Engineering Design - "*A Materials and Processing Approach*", McGraw Hill International Editions, Singapore, 3rd Edition, 2000.
2.	Karl T. Ulrich and Steven D. Eppinger "*Product Design and Development*" McGraw Hill Edition 4th edition 2009
	Reference Books/Other Reading Material
3.	Pahl, G, and Beitz, W.," *Engineering Design*", Springer – Verlag, NY. 1984
4.	Ray, M.S., "*Elements of Engg. Design*", Prentice Hall Inc. 1985.
5.	Suh, N.P., "*The principles of Design*", Oxford University Press, NY.1990.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage		**50%**

Vehicular Electronics and Control Technology

15AE251E	Automotive Control Systems	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	15AE202				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Elective	Vehicular ElectronicsAAnd Control Technology			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To understand the importance and use control theory concepts for automotive control applications.						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand and Mathematically Model an automotive sub-system	a	b		k		
2.	Perform time response and frequency response analysis for the system under study	a		e	k		
3.	Perform Stability analysis of system under study.	a	b	e	k		
4.	Understand the basics of State variable analysis.	a		e	k		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction to Control Systems and Mathematical Modelling Systems	**9**			
1.	Introduction To Control Systems And History Of Automatic Control	1	C	1	1
2.	Examples Of Automotive Control Systems-Steering Control, Cruise Control, Adaptive Suspension System, Future Evolution Of Control System.	1	C,D	1	1
3.	Differential Equation Of Physical Systems And Transfer Function Of Linear Systems	1	C,D	1	1
4.	Transfer Function Of A D.C Motor, Throttle Position Sensor, Velocity Sensor, Accelerometer, Gear Train And Rack-Pinion System	1	C,D	1	1
5.	Block Diagram Transformation And Block Diagram Reduction For Finding Closed Loop Transfer Functions.	2	C,D	1	1
6.	Signal Flow Graphs Models And Mason's Gain Formula And Transfer Function Of Multiple-Loop System	2	C,D	1	1,2
7.	Introduction To CACSD Tools And Simulation Of Mathematical Models	1	C,D	1	1
	Unit II: Feedback Control System Characteristics and Performance	**8**			
8.	Introduction To Time Response Analysis-Error Signal Analysis	1	C	2	1
9.	Sensitivity Of Control System, Disturbances Test Input Signals, Steady State And Transient Response, Time Response Analysis Of First Order System.	1	C,D	2	1,2
10.	Time Response Analysis Of Second Order System	2	C,D	2	1,2
11.	S-Plane Root Location And Transient Response, Steady State Error Of Feedback Control System	1	C,D	2	1
12.	Time Domain Specifications And Performance Using Control Design Software.	**1**	C,D	2	
13.	Time Response Analysis Of Cruise Control System And Mobile Robot Steering Control	2	C,D	1,2	1,2
	Unit III:Stability Analysis of Linear Feedback System	**8**			
14.	Introduction To Concept Of Stability.	1	C,D	3	1
15.	Routh –Hurwitz Stability Criterion.	1	C,D	3	1,2
16.	Stability Analysis Of Tracked Vehicle Turning Control.	1	C,D	3	1
17.	Introduction To Root Locus Concept.	1	C	3	1,2

18.	The Rootlocus Procedure And Rootlocus Analysis.	2	C,D	3	2
19.	Three Term (PID) Controller	1	C,D	3	1
20.	Case Study On Automobile Velocity Control In An IVHS,Root Locus Using Control Design Software.	1	C,D	1,3	1
	Unit IV:Frequency Response Analysis	**8**			
21.	Frequency Response Plots, Performance Specification, Log Magnitude And Phase Diagrams	3	C,D	2	1,2
22.	Frequency Response Methods Using Control Design Software	1	C,D	2	1
23.	Nyquist Stability Criterion, Relative Stability, Nyquist Plot, Pid Controller In Frequency Domain, Lead, Lag And Lead-Lag Compensators.	4	C,D	2,3	1,2
	Unit V:State Variable Models And Analysis	**8**			
24.	Introduction To State Space And State Variable Models	1	D	4	1
25.	State Variable Of A Dynamic System, State Differential Equation, Transfer Function From State Equation, Time Response And State Transition Matrix	3	C	4	1
26.	Introduction To Controllability, Observability And Full State Feedback	2	C	4	1,2
27.	Analysis Of A State Variable Model Using Control Design Software For A Segway Using Inverted Pendulum Model	2	C,D	1,4	1,2
28.	Cycle test-I	1			
29.	Cycle test-II	2			
30.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Richard.C.Dorf and Robert.H.Bishop , "*Modern Control System*" 12th edition Pearson Prentice Hall,2013.
2.	Benjamin.C.Kuo, "*Automatic control systems*", Prentice Hall of India, 7th Edition, 1995.
	Reference Books/Other Reading Material
3.	J.Nagrath and M.Gopal, "*Control System Engineering*", New Age International Publishers, 5th Edition, 2007.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE252E	**Microcontrollers for Automotive Applications**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE202						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicular Electronics and Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

PURPOSE	To understand the importance of microcontrollers and to learn Microcontrollers Programming for Automotive Electronics and Control applications.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand 8051 Microcontroller architecture	a	b	d		
2.	Understand Program 8051 using Assembly level programming	a	b	d	e	k
3.	Understand the use of high level programming language for embedded application	a	b	d		k
4.	Understand the internals of PIC16F887 and program it using C.	a	b	d		k

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: 8051 Architecture	**7**			
1.	Introduction To Microprocessors And Microcontrollers	1	C	1	1
2.	8051 Architecture-Clock, PC,DP,CPU Registers, PSW,RAM,ROM,SP,SFR,IO Ports, Connecting External Memory, Counters, Timers, Serial Data Input/Output, Interrupts	4	C,D	1	1
3.	Moving Data –Addressing Modes, Push, Pop Instructions	2	C,D	1	1
	Unit II: Programming 8051	**10**			
4.	Logical Operations-Bit Level, Byte Level, Rotate And Swap Operation	1	C,D	1,2	1
5.	Arithmetic Operations-Incrementing, Decrementing, Addition, Subtraction	1	C,D	1,2	1
6.	Jumps, Calls And Subroutines, Interrupts And Return	1	C,D	1,2	1
7.	Expanding I/O, Memory Mapped I/O	1	C	1,2	1
8.	Timing Subroutine-Software Delay, Hardware Delay	1	C,D	2	1
9.	Lookup Table For 8051,PC As Base Address, DPTR As Base Address	1	C,D	2	1
10.	Serial Data Transmission-Polling And Interrupt Driven For Transmission And Reception	2	C,D	2	1
11.	Application Programming-Scanning Keyboard Inputs And Analog Digital Conversions	2	C,D	2	1
	Unit III: Introduction to Embedded C	**8**			
12.	Program Languages For Embedded System Application-Advantages Of Higher Level Programming Language	1	C	3	2
13.	Basics Of C Program Language –Data Types, Variables, Keywords, Pointers, Declarations, Constants, Operators	2	C,D	3	2
14.	Data Type Conversions, Switch, If, For, While , Arrays, Functions, Structure	4	C,D	3	2
15.	Embedded Programming Tool Chain –IDE With Simulator	1	C,D	3	2
	Unit IV:PIC16F 887 Microcontroller	**8**			
16.	PIC16F 887 –Basic Features, Core SFR'S and Ports	1	C,D	4	2,3
17.	PIC-Timer TMR0,TMR1,TMR2	1	C,D	4	2,3
18.	PIC-Capture Compare Module-CCM in PWM Mode	2	C,D	4	2,3
19.	PIC-Serial Communication Modules	1	C,D	4	2,3
20.	Analog Modules –A/D convertor, Comparator	1	C,D	4	2,3
21.	Clock Oscillator Configurations	1	C,D	4	2,3
22.	EEPROM Configurations	1	C,D	4	2,3
	Unit V: Programming PIC16F887	**8**			
23.	Writing header, configuring I/O pins, using delay function and switch operator	1	C,D	4	2
24.	Programming TMR0 as Counter using Relays	1	C,D	4	2
25.	Programming Timers and Interrupts	1	C,D	4	2
26.	Programming Watchdog Timers	1	C,D	4	2
27.	Programming CCP1 for PWM applications	1	C,D	4	1
28.	Programming Analog to Digital Convertor	1	C,D	4	1
29.	Programming EEPROM	1	C,D	4	2
30.	Programming Serial Communication And 1-Wire Protocol For Sensor Data Acquisition.	1	C,D	4	2
31.	Cycle test-I	1			
32.	Cycle test-II	2			
33.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Kenneth.J.Ayala "*The 8051 Microcontroller,Architecture,Programming and Application*" West Publishing Company,1991
2.	Milan Verle "*PIC Microcontroller Programming in C*" Mikroelektronika 2008
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Tim Willmhurst "*Designing Embedded System with PIC Microcontrollers*" Newnes,1st Edition 2007

Course nature				Theory			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE351E	**Automotive Fault Diagnostics**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicular Electronics and Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To understand the importance and procedure of fault diagnostics in for automotive field.						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand the concept of fault diagnosis	a	b		d		k
2.	Understand about on and off board diagnostics	a		c			k
3.	Perform fault diagnosis in automobiles	a			d	e	k
4.	Understand the various advances in fault diagnosis	a				e	k

Session	Description of topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction Fault Diagnosis	**8**			
1.	Introduction To Fault Diagnosis, Safe Working Practices And Techniques	1	C	1	1,2
2.	Diagnostics On Paper, Mechanical And Electrical Diagnostic Techniques	1	C,D	1	1,2
3.	Faults Codes, Systems And Standards	1	C,D	1	1,2
4.	On - And - Off Board Diagnostics	1	C,D	1	1
5.	Data Sources, Tools And Equipments	1	C,D	1	1
6.	Oscilloscopes, Scanners/Fault Code Readers, Engine Analyzers	2	C,D	1	1,2
7.	Application Methods And Procedures	1	C,D	1	1
	Unit II: On and off Board Diagnostics	**8**			
8.	Introduction To Oscilloscope Diagnostics	1	C	2	1,2
9.	Sensors And Actuators Associated With Oscilloscope Diagnostics	1	C,D	2	1,2
10.	On-Board Diagnostics Various Perspectives	2	C,D	2	1,2
11.	Petrol/Gasoline On-Board Diagnostics	1	C,D	2	1
12.	On-Board Sensors And Actuators	1	C,D	2	1,2
13.	Sensors And Actuators Comparative Case Study	2	C,D	1,2	1,2
	Unit III: Engine System Diagnosis	**8**			
14.	Introduction Engine Systems Diagnostics	1	C,D	3	2
15.	Engine Operation And Fuel System	1	C,D	3	2,3
16.	Ignition System And Emission System	1	C,D	3	2,3
17.	Fuel Injection, Starting And Charging System	1	C	3	2,3
18.	Power Flow Control And Energy Efficiency Analysis	1	C,D	3	3
19.	Engine Management And Faultfinding Information	2	C,D	3	2
20.	Air Supply, Exhaust System, Cooling And Lubrication System	1	C,D	3	2,3
	Unit IV: Chassis and Brake System Diagnosis	**8**			
21.	Introduction To Engine System Diagnostics	1	C	3	2,3
22.	Anti-Lock Braking System Diagnostics	1	C,D	3	2,3
23.	Traction Control System Diagnostics, Steering And Tires	1	C,D	3	2,3
24.	Transmission Systems Diagnostics	2	C,D	3	2,3

25.	Diagnostics On Steering And Tires	2	C,D	3	2,3
26.	Case Study On Diagnostics Of Sub Assemblies	2	C,D	3	2,3
	Unit V:Electrical Systems Diagnosis	**9**			
27.	Introduction To Electronic Components And Circuits	1	C	3,4	4
28.	Multiplexing And De Multiplexing	1	C,D	3,4	4
29.	Lighting System Faults And Auxiliary Faults	1	C,D	3,4	4
30.	In-Car Entertainment Security And Communications Implementation	1	C,D	3,4	4
31.	Body-Electrical Systems, Instruments System Faults	1	C,D	3,4	4
32.	Heating Ventilation And Air Conditioning	2	C,D	3,4	4
33.	Cruise Control, Air Bags And Belt Tensioners	2	C,D	3,4	4
34.	Cycle test-I	1			
35.	Cycle test-II	2			
36.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Tom denton "*Advanced automotive fault diagnosis*", Elsevier butterworth-heinemann linacre house, jordan hill, oxford ox2 8dp, uk - isbn-10: 0-75-066991-8
2.	Tom Denton "*Automotive Electronics Handbook*", - - McGraw-Hill Publishing Co.; 2nd Revised edition 1999, ISBN10:0070344531
	Reference Books/Other Reading Material
3.	Routledge "*Automobile Electrical and Electronic Systems*", 4 edition 2012, ISBN10: 0080969429
4.	Newnes "*Understanding Automotive Electronics*", 6th Revised edition 2003,ISBN10:0750675993

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination weightage :	**50%**

15AE352E	**Automotive Communication Protocols**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE252E						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicular Electronics And Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To understand the various inter and intra-vehicular communications protocols and associated technologies.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand vehicular communication networks	a	d	e		
2.	Understand the physical layer and working of CAN,LIN protocols	a	d	e		
3.	Understand the technologies of in-vehicle and inter-vehicle networks	a	d	e		

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Introduction to Vehicle Communications	**8**			
1.	Introduction To Intra-Vehicle Communication Protocols And Functions	1	C	1	1
2.	Communications Protocols-Communication Between Sensors And Systems (Power Train, Chassis Systems, Body Electronics, Instrument Clusters, Infotainment Systems)	3	C	1	1
3.	Inter-Vehicle Communications-Co Operative Driving (Accident Warning, Frontal/Rear Collision Prevention, Lane	2	C	1	1

	Change, Assistance).				
4.	Consumer Assistance –Traffic Information, Multimedia Support And Smart Parking	2	C	1	1
	Unit II: Communication Fundamentals and Technologies	**8**			
5.	Communication Fundamentals –Frequency, Bandwidth, Power Measurement, SNR, Transmission Rate Constraints	1	C,D	3	1
6.	Radio Frequency Spectrum allocation—RADAR Operation, Types of RADAR –Laser RADAR, Collision avoidance RADAR ,IEEE Wireless LAN standards.	3	C	1,3	1
7.	Communication Technologies –Transmission Technologies, GSM, CDMA, Bluetooth, WLAN	2	C	3	1
8.	MANET-Mesh Networking, Networking formation and Area of coverage	2	C	3	1
	Unit III :Local Interconnect Network and Controller Area Network	**8**			
9.	LIN –Goals and Applications	1	C	2	1
10.	LIN Specification-Physical Layer, Master Slave relationship, Data link Layer.	1	C	2	1
11.	CAN Evolution, Versions, Types of Controllers, Layered Architecture	1	C	2	1
12	CAN Bus Signaling states, Physical Layer, Data Transmission, Bus speed and Termination, Cable Connectors.	1	C	2	1
13.	CAN Message Frames-Data Frame, Bit stuffing, Remote Frame ,Error Frame, Overload Frame, CAN Bus Arbitration	1	C,D	2	1
14.	Error Handling and Error Detecting Mechanism	1	C,D	2	1
15.	CAN Controller Operation-Controller states, Mode Control, Counter Updating, Receive-Transmit error counter	2	C,D	2	1
	Unit IV :Intra-Vehicle Communications	**8**			
16.	Wired Communication – Network Comparison, Two Tier Approach	1	C	3	1
17.	LIN Applications- Localized vehicle area support, General Support areas	1	C	3	1
18.	CAN Applications- In vehicle operation, Infotainment	2	C	3	1
19.	Wireless Communication –Bluetooth Vehicle applications	2	C	3	1
20.	Satellite Services –Satellite Radio, Vehicle Care, Traffic Status	2	C	3	1
	Unit V – Inter-Vehicle Communication	**9**			
21.	Adhoc Communications –Applications in Vehicle traffic Monitoring, Collision and congestion avoidance, Highway lane reservation, Emission Control	2	C,D	3	1
22.	Vehicle Frequency Utilization –AM Radio, Bluetooth, FM Radio, GPS, Short range RADAR, Wireless LAN	2	C	3	1
23.	Intelligent Roadway-Infrastructure to vehicle and vehicle to vehicle communications.	2	C,D	3	1
24.	Evolving Smart Vehicle – ECU, Wireless Networking, Forward RADAR, Side RADAR, GPS, Cellular transmission and Event Recorder.	3	C	3	1
25.	Cycle test-I	1			
26.	Cycle test-II	2			
27.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Gilbert Held "*Inter and Intra Vehicle Communications",* Auerbach Publications,2008
	Reference Books/Other Reading Material
2.	Tao Zhang , Luca Delgrossi "*Vehicle Safety Communications Protocols, Security, and Privacy*".,Information Communication technology series,2012
3.	Mohamed Kassab "*Communication Technologies for Vehicles*" Springer, 2015

Course nature				Theory			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE353E	**Artificial Neural Networks and Fuzzy Logic**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicular Electronics and Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To understand the Concepts and applications of Artificial Neural Network and Fuzzy Logic.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the concept of Neural Network Models and Learning algorithm	a		e	k	
2.	Understand the concepts and implementation of fuzzy logic and fuzzy logic controllers	a		e	k	
3.	Understand Hybrid systems such as Neuro fuzzy systems	a		e	k	
4.	Understand basic Hardware implementation of Fuzzy and neuron	a	b	e	k	

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Introduction To Neural Networks	**8**			
1.	Introduction to ANN	1	C	1	1,2
2.	Structure of Neural Network	1	C	1	2
3.	Output of a Neuron	1	C	1	2
4.	Supervised and unsupervised learning	1	C	1	2
5.	Perception and Multilayer Perception	1	C	1	1
6.	Feed forward Network and Hopfield Network	1	C	1	1,2
7.	Neural Network Models –Adaline, Madaline and Back propagation Network	2	C,D	1	2
	Unit II: Neural Network Models	**8**			
8.	Neural Network-Feed Forward Back Propagation Network Application	1	C	1	1
9.	Layers In Neural Network-Single Layer, Multilayer	1	C	1	1,2
10.	XOR Function And Linear Separability	1	C	1	1,2
11.	Threshold Functions-Sigmoid Function, Step Function, Ramp Function And Linear Function	1	C	1	2
12.	Function Approximation With Neural Networks	1	C	1	3
13.	System Identification With Neural Networks	1	C	1	3
14.	Control With Neural Networks	2	C	1	3
	Unit III: Fuzzy Sets And Fuzzy Relations	**8**			
15.	Basic Concepts Of Classical Sets, Set Operation, Boolean Logic	1	C,D	2	1
16.	Basics Of Fuzzy Sets, Other Representation Of Fuzzy Sets	1	C,D	2	1
17.	Fuzzy Membership Function-Trapezoidal, Gaussian And Its Determination	1	C,D	2	1
18.	Fuzzy Set Properties, Operations –Logic Operation And Algebraic Operations.	1	C	2	1
19.	Introduction To Classical Relations And Reasoning	1	C	2	1
20.	Fundamentals Of Fuzzy Relations –Operation On Binary Fuzzy Relation	1	C,D	2	1
21.	Types Of Fuzzy Relations And Fuzzy Reasoning	2	C,D	2	1
	Unit IV: Embedded Fuzzy Application	**8**			

22.	Introduction to conventional Control System –Description, Analysis, Design and PID control	4	C,D	2	1
23.	Fuzzy logic Controller (FLC) –Description, Design, Fuzzification, Knowledge base and Defuzzification –Analysis with computer aided Tools.	3	C,D	2	1
24.	Case study on Fuzzy logic Controller for Automotive Embedded System application.	1	C,D	2	1
	Unit V: Hybrid Systems And Hardware Implementation	**9**			
25.	Introduction to Hybrid Systems, Fuzzy Neuron	1	C	3	1
26.	Multilayer FNN architectures	1	C	3	1
27.	Fuzzy ART, Fuzzy ARTMAP	1	C	3	1
28.	Neural-Fuzzy system and its applications	1	C	3	1
29.	Hardware Implementation –Analog Techniques, Digital Techniques	3	C,D	4	1
30.	Fuzzy Memory and OP-Amp based implementation of basic Neuron Model	2	C,D	4	1
31.	Cycle test-I	1			
32.	Cycle test-II	2			
33.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Ahmad.M.Ibrahim "*Fuzzy logic for Embedded System application*" -Newness 2004,ISBN: 0-7506-7699-
2.	Valluru B.Rao " *C++,Neural Network and Fuzzy logic*"., -M&T Books ,IDG books Worldwide,ISBN1558515526
3.	M.Gopal "*Digital Control and State Variable Methods*"-2nd edition, Tata McGraw Hill Publishing,2006
	Reference Books/Other Reading Material
4.	Simon Haykin " *Neural Networks and Learning Machines* –3rd Edition- Pearson Prentice Hall-ISBN-13: 978-0131471399.
5.	Guanrong Chen "*Introduction to Fuzzy Sets,Fuzzy logic and Fuzzy control System*" Trung Tat Pham-CRC Press -ISBN 0-8493-1658-8

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE354E	**Electric and Hybrid Vehicles**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicular Electronics and Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To understand the principle, working and design of electric and hybrid vehicles.					
Instructional objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand electric vehicle technology and electric vehicles	a	c	d	e	
2.	Understand the basics of hybrid and electric drive trains	a	c	d	e	
3.	Perform design calculations of hybrid system under study	a	c	e	k	
4.	Understand the various vehicle power sources in hybrid vehicle technology	a	b	e		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Electric Vehicle Propulsion And Energy Sources	**9**			
1.	Introduction Electric Vehicles	1	C	1	1
2.	Vehicle Mechanics - Kinetics And Dynamics, Roadway Fundamentals	1	C	1	1
3.	Propulsion System Design - Force Velocity Characteristics, Calculation Of Tractive Power And Energy Required	1	C,D	1	1
4.	Electric Vehicle Power Source - Battery Capacity, State Of Charge And Discharge , Specific Energy, Specific Power, Ragone Plot	1	C,D	1	1
5.	Battery Modeling - Run Time Battery Model, First Principle Model	2	C,D	1	1
6.	Battery Management System- SOC Measurement, Battery Cell Balancing.	2	C,D	1	1
7.	Traction Batteries - Nickel Metal Hydride Battery, Li-Ion, Li-Polymer Battery.	1	C,D	1	1
	Unit II: Electric Vehicle Powerplant And Drives	**8**			
8.	Introduction Electric Vehicle Power Plants	1	C	1,2	2
9.	Induction Machines, Permanent Magnet Machines, Switch Reluctance Machines	2	C	1,2	2,3
10.	Power Electronic Converters-DC/DC Converters - Buck Boost Converter, Isolated DC/DC Converter	2	C,D	1,2	2,3
11.	Two Quadrant Chopper And Switching Modes	1	C,D	1,2	2,3
12.	AC Drives- PWM, Current Control Method	1	C,D	1,2	2,3
13.	Switch Reluctance Machine Drives - Voltage Control, Current Control	1	C,D	1,2	2,3
	Unit III: Hybrid And Electric Drivetrains	**8**			
14.	Introduction Hybrid Electric Vehicles, History And Social Importance	1	C	3	1,3
15.	Impact Of Modern Drive Trains In Energy Supplies	1	C	3	1,3
16.	Hybrid Traction And Electric Traction	1	C,D	3	1,3
17.	Hybrid And Electric Drive Train Topologies	1	C	3	1,3
18.	Power Flow Control And Energy Efficiency Analysis	2	C,D	3	1,3
19.	Configuration And Control Of Dc Motor Drives And Induction Motor Drives	1	C,D	3	1,3
20.	Permanent Magnet Motor Drives, Switch Reluctance Motor Drives, Drive System Efficiency	1	C,D	3	1,3
	Unit IV: Electric And Hybrid Vehicles - Case Studies	**8**			
21.	Parallel Hybrid, Series Hybrid -Charge Sustaining, Charge Depleting	1	C	4	1,4
22.	Hybrid Vehicle Case Study –Toyota Prius, Honda Insight, Chevrolet Volt	1	C,D	4	1,4
23.	42 V System For Traction Applications	1	C,D	4	1,4
24.	Lightly Hybridized Vehicles And Low Voltage System	1	C	4	1,3
25.	Electric Vehicle Case Study - GM EV1,Nissan Leaf, Mitsubishi Miev	2	C,D	4	2,3
26.	Hybrid Electric Heavy Duty Vehicles, Fuel Cell Heavy Duty Vehicles	2	C,D	4	1
	Unit V: Electric And Hybrid Vehicle Design	**8**			
27.	Introduction To Hybrid Vehicle Design	1	C	1,3	1
28.	Matching The Electric Machine And The Internal Combustion Engine	1	C,D	1,3	1,4
29.	Sizing Of Propulsion Motor, Power Electronics, Drive System. Selection Of Energy Storage Technology, Communications, Supporting Subsystem	2	C,D	1,3	3,4
30.	Energy Management Strategies In Hybrid And Electric Vehicles - Energy Management Strategies- Classification, Comparison, Implementation	2	C,D	1,3	1,2

31.	Design Of A Hybrid Electric Vehicle	1	C,D	1,3	1
32.	Design Of A Battery Electric Vehicle	1	C,D	2,4	2
33.	Cycle test-I	1			
34.	Cycle test-II	2			
35.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Iqbal Husain, "*Electic and Hybrid vehicles Design Fundamentals*" , CRC Press, second enition 2013
2.	James Larminie, John Lowry, "*Electric vehicle techonology Explained*" second Edition,Wiley 2012
	Reference Books/Other Reading Material
3.	Ali Emadi, "*Hand book of Automotive Power Electronics and Motor Drives*" ,CRC Press 2005
4.	Ali Emadi, Mehrdad Ehsani, John M. Muller,"*Vehicular Electric Power Systems*" Marcel Dekker, Inc., 2004

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE451E	**Intelligent Vehicle Technology**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional elective	Vehicular Electronics And Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To understand the advanced vision system in vehicles, Autonomous vehicles and Intelligent Transportation System					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the intelligent vision system used in automobiles	a	c			
2.	Understand the architecture of intelligent transportation system	a	d			
3.	Understand adaptive control techniques of an autonomous vehicle	a	d	k		
4.	Understand about the successful autonomous vehicle projects	a	d			

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Introduction to Intelligent Vision System	**9**			
1.	Vision Based Driver Assistance System –Vehicle optical Sensor, Laser Radar	2	C	1	1
2.	Non Contact ground velocity detecting Sensor, Road Surface Recognition Sensor	2	C	1	1
3.	Vehicle Sensors for Electronic Toll Collection System	1	C,D	1	1
4.	Components of a Vision Sensor System , Driver Assistance on Highways –Lane Recognition, Traffic Sign Recognition	2	C	1	1
5.	Driver Assistance in Urban Traffic-Stereo Vision, Shape base analysis and Pedestrian Recognition	2	C	1	1
	Unit II: Vehicle Information System and Intelligent Transportation	**8**			
6.	Intelligent Transportation System (ITS) – Vision for ITS Communications	1	C	2	1
7.	Multimedia communication in a car –Current ITS Communication Systems and Services	1	C	2	1,2
8.	Vehicle to Vehicle and Road to Vehicle Communication Systems	2	C,D	2	1
9.	Inter and Intra Vehicle Communication	1	C,D	2	1

10.	VANETS-Devices-Optical Technologies and Millimeter Wave technologies	3	C	2	1
	Unit III: Adaptive Control Techniques for Intelligent Vehicles	**8**			
11.	Automatic Control Of Highway Traffic And Moving Vehicles	1	C	3	1
12.	Adaptive Control Of Highway Traffic And Moving Vehicles	1	C	3	1
13.	Adaptive Control –Gain Scheduling	1	C,D	3	1
14.	Model Reference Adaptive Control	1	C	3	1
15.	Self Tuning Adaptive Control System Model - System Identification Basics, Recursive Parameter Estimation, Estimator Initialization	2	C,D	3	1
16.	Design Of Self-Tuning Controllers –Generalized Minimum Variance (GMV) Control, Pole Placement Control And Model Predictive Control.	2	C,D	3	1
	Unit IV: Decisional Architechtures for Autonomous Vehicles	**8**			
17.	Control Architectures And Motion Autonomy –Deliberative Architectures, Reactive Architectures, Hybrid Architectures.	2	C,D	3	1,3
18.	Overview Of Sharp Architecture, Models Of Vehicles	1	C,D	3	1,3
19.	Concepts Of Sensor Based Maneuver, Reactive Trajectory Following, Parallel Parking, Platooning	2	C,D	3	1,3
20.	Main Approaches To Trajectory Planning, Non-Holonomic Path Planning.	3	C,D	3	1,3
	Unit V: Autonomous Vehicle and Case Studies	**8**			
21.	DARPA Challenge Case Study	1	C	4	1,3
22.	ARGO Prototype Vehicle	1	C	4	1,3
23.	The Gold System-The inverse Perspective Mapping ,Lane Detection, Obstacle Detection, Vehicle Detection, Pedestrian Detection.	2	C	4	1
24.	Software systems architecture, Computational Performances.	1	C	4	1
25.	ARGO Prototype vehicle Hardware –Functionalities, Data acquisition System, Processing System and Control System	3	C	4	1,3
26.	Cycle test-I	1			
27.	Cycle test-II	2			
28.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Ljubo Vlacic, Michel Parent and Fumio Harashima,"*Intelligent Vehicle Technologies*", Butterworth-Heinemann publications, Oxford, 2001-ISBN 0 7506 5093 1
2.	Ronald K Jurgen, "*Automotive Electronics Handbook* ", Automotive Electronics Series, SAE, USA, 1998.
	Reference Books/Other Reading Material
3.	Nicu Bizon,Lucian D Ascalescu And Naser Mahdavit Abatabaei "*Autonomous Vehicles Intelligent Transport Systems And Smart Technologies*",Nova Publishers-2014–ISBN-978-1-63321-326-5

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE452E	**Model Based System Design**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE251E						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicular Electronics and Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To understand the Concepts and implementation of model based system design						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand the concept of V-development approach in automotive controller design	a	b	d	e	k	
2.	Understand the various modeling techniques used in model based system design	a	b		e	k	
3.	Understand the architecture of ECU and Rapid prototyping Hardware	a	b		e	k	
4.	Understand the concept of real time simulation and HIL simulation through a case study	a	b	d	e	k	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Model Based Design Approach	**9**			
1.	Introduction to model based design	1	C	1	1
2.	Introduction to the design process, validation verification and requirements, Design and verification process	2	C	1	1
3.	Model based system design in Functional level, Architectural level, Implementation level.	2	C	1	1
4.	Keys and barriers to adoption of model based engineering	1	C	1	1
5.	V-development approach in automotive domain (Rapid control prototyping -MIL, SIL, PIL, HIL).	3	C	1	1
	Unit II: Modeling Techniques	**9**			
6.	Introduction to graphical modeling	1	C	2	1
7.	Signal flow modeling, state machines modeling	2	C,D	2	1
8.	Algorithmic models, Transfer function modeling	1	C,D	2	1
9.	State space modeling, Event based modeling	2	C,D	2	1
10.	Statistical modeling for system identification	1	C	2	1
11.	Mathematical modeling for automotive applications	1	C,D	2	1
12.	Simple Motor model and generator model development.	1	C,D	2	1
	Unit III: Ecu Architecture and Design	9			
13.	Rapid Prototyping hardware architecture and features	1	C	3	3
14.	Programming analog , digital interface ,Protocol interface and implementing controller	2	C	3	3
15.	ECU Design - Need for ECUs, Advances in ECUs for automotives	1	C	3	3
16.	Design complexities of ECU, Design requirements of ECU design	1	C	3	3
17.	Selection of sensors and interfaces for ECU design	1	C	3	3
18.	ECU Hardware -Architecture of an advanced microcontroller used in the design of automobile ECUs	1	C	3	3
19.	On Chip peripherals, protocol interfaces and GPIO	2	C	3	3
	Unit IV: Realtime Simulation	**9**			
20.	Plant and Controller stand alone simulation	1	C,D	4	3
21	Plant and controller implementation on single target	1	C,D	4	3
22.	RT simulation by Separating the plant from the controller	1	C,D	4	3
23.	Controller and plant on real time target	1	C,D	4	3
24.	V and V using HIL RT Model	2	C,D	1,4	3
25.	Implementation of communication interfaces, A/D Outputs	2	C,D	4	3
26.	Verifying timing requirements of Control algorithm	**1**	C,D	4	3
	Unit V: Model Based System Design and Case Study	**9**			
27.	Modeling a series hybrid electric vehicle –simulink and sim driveline	2	C,D	4	2,3
28.	Models for driver, battery and Electric motors –creating and running drive cycles	2	C,D	4	3
29.	Models for Engine	2	C,D	4	3
30.	Developing Hybrid vehicle Model	2	C,D	4	3

31.	Supervisory logic implementation and HIL simulation of Hybrid vehicle.	1	C,D	4	3
32.	Cycle test-I	1			
33.	Cycle test-II	2			
34.	Surprise Test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Peter Wilson and H.Alan Mantooth "*Model based Engineering for complex Electronics system*" 2013,Newness
2.	AgamKumar Tyagi "*Matlab and simulink for Engineers*" Oxford Higher education,2012
	Reference Books/Other Reading Material
3.	Webcourse by Zachariah chambers and Marc Herniter –Rose Hulman institute of technology on "*Introduction to model based design and Advanced model based design*."

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE453E	**Vehicle Stability and Control Systems**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE251E						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Vehicular Electronics and Control Technology				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To understand the importance and use control theory concepts for vehicle stability.						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand the concepts of vehicle stability and fundamentals of vehicle dynamics.	a	b	c	d	e	k
2.	Understand the concepts of Vehicle, Road and driver modeling.	a	b		d	e	k
3.	Understand the concepts longitudinal and Lateral stability control	a	b		d	e	k
4.	Understand the concepts of vertical and ride stability control	a	b		d		k

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Introduction to Vehicle Stability	**9**			
1.	Introduction to stability of motion – Concept and analysis	1	C	1	1
2.	Static and Dynamic stability, Mathematical forms for vehicle dynamic equations.	1	C,D	1	1
3.	Computing Eigen values and Routh's stability criterion	2	C,D	1	1
4.	Co-ordinates and notation of vehicle dynamics model	1	C,D	1	2
5.	Longitudinal vehicle motion –During acceleration, Braking	1	C,D	3	2
6.	Vertical vehicle motion – one DOF quarter car model	1	C,D	4	2,3
7.	Lateral vehicle motion –Bicycle model in steady state cornering	2	C,D	3	2,3
	Unit II: Vehicle, Road and Driver Modeling	**8**			
8.	Introduction to Vehicle Modeling	1	C	2	3,4
9.	Wheel Model – Wheel and ground point velocities, Wheel slip and tire side slip angle.	1	C,D	2	4
10.	Friction coefficient and forces calculation,	1	C,D	2	4

11.	Tire characteristics and wheel radius	1	C,D	2	4
12.	Complete vehicle model – Chassis translator y motion, Chassis rotational motion	1	C,D	2	4
13.	Reduced two track non-linear model	1	C,D	,2	4
14.	Road Model – Requirement of road model, course path, Road surface and Wind Strength	1	C,D		4
15.	Human factors in driver automation ,PID driver Model	1	C,D	2	3,4
	Unit III: Longitudinal Dynamics and Control	**8**			
16.	Introduction to longitudinal control – ACC, Collision avoidance, Automated Highway systems	1	C,D	3	1
17.	Cruise controller design, PI Controller for first order plant	1	C,D	3	1,2
18.	PID Cruise-controller design for second order actuator	1	C,D	3	1
19.	Autonomous cruise control –Speed and Headway control	1	C	3	1,2
20.	Adaptive cruise control –Cruise control with preview based on onsite information	1	C,D	3	2
21	Vehicle Platooning and string stability	1	C		
22.	ACC –Autonomous control with constant spacing	1	C,D	3	1
23.	ACC – Autonomous control with constant time gap policy and String stability of CTG spacing Policy	1	C,D	1,3	1
	Unit IV: Lateral Dynamics and Control	**8**			
24.	Steering control for automated lane keeping – Bicycle model and state feedback	1	C,D	3	1,2
25.	Steady state error from dynamic equation	1	C,D	3	1
26.	Unity feedback loop system	1	C,D	3	1,2
27.	Loop analysis with a proportional controller	1	C,D	3	3
28.	Loop analysis with a lead compensator	1	C,D	3	3
29.	Simulation of performance with Lead compensator	1	C,D	3	3
30.	Four wheel steering –Goals of four wheel steering	1	C,D	3	2
31.	Yaw rate and acceleration response, Lane Change Maneuver – 2WS VS 4WS	1	C,D	3	2
	Unit V : Vertical Dynamics and Control	8			
33.	Introduction to Automotive Suspension –Passive suspension ,Active suspension -Trade offs and Limitation	1	C	4	3
34.	Performance variable of quarter car suspension	1	C,D	4	3
35.	Natural Frequencies and Mode Shapes for the Quarter Car	1	C,D	4	3
36.	Approximate Transfer Functions Using Decoupling	1	C,D	4	3
37.	Verification Using the Complete Quarter Model	1	C,D	4	3
38.	Optimal active Suspension with 2DOF model	1	C,D	4	2,3
39.	LQR formulation for active suspension design	1	C,D	4	3
40.	Performance studies of the LQR controller, Conclusions on Achievable Active System Performance	1	C,D	4	3
42.	Cycle test-I	1			
43.	Cycle test-II	2			
44.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Dean Karnopp "*Vehicle Stability*" ,4th edition Marcel Dekker 2004
2.	A.Galip Ulsoy,Heui Peng,Melih "*Automotive Control system*" ,Cambridge University Press 2012
3.	Rajesh Rajamani "*Vehicle Dynamics and Control*" Springer 2006
4.	Uwe,Lars Nielsen "*Automotive Control System for Engine driveline and vehicle*" 2nd edition ,Springer 2005
	Reference Books/Other Reading Material
5.	Richard.C.Dorf and Robert.H.Bishop , "*Modern Control System*" 12th edition Pearson Prentice Hall,2013.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE361E	HVAC	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	15AE204				
Data Book / Codes/Standards	Psychometric chart and Refrigerant table				
Course Category	P Professional - Elective	Engine			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To acquire the knowledge of different atmospheric conditions in order to maintain the required space temperature.						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will able to							
1.	Understand the basic concepts of Heat, Ventilation, and Air conditioning.	a					
2.	Solve heating and cooling load calculations for different ambient conditions.	a	c	d	e		
3.	Equip themselves familiar with functions of refrigerating components.		c				
4.	Select refrigerant with less GWP and ODP					h	
5.	Know the different types of fan and its characteristics	a		d			

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Air Conditioning Fundamentals	**8**			
1.	Basic Air Conditioning System , Location Of Air Conditioning Components In A Car	1	C	1	1,2
2.	Schematic Layout Of A Refrigeration System	1	C	1	1
3.	Terminologies In HVAC: TR, COP, EER, SEER - Heat Exchanger And Its Types	3	C,D	1	1
4.	Air Conditioning Components – Compressor, Condenser, Evaporator Expansion Valve	3	C	1,3	1,2
	Unit II: Psychrometry	**8**			
5.	Properties Of Moist Air, Psychrometric Properties	1	C	1,2	1,3,4
6.	Use Of Psychrometric Chart	2	C	1,2	1
7.	Psychrometric Processes In Air Conditioning Equipment	2	C	1,2	1
8.	Summer Air Conditioning	2	C,D	1,2	1,2
9.	Winter Air Conditioning	1	C,D	1,2	1,2
	UNIT III: Load Calculation	**10**			
10.	Solar Radiation – Internal Heat Gains, Humidity And Air Flow	2	C,D	1,2	1
11.	Heating Load Estimate And Cooling Load Estimate	4	C,D,	1,2	1
12.	Psychrometric Calculations For Cooling	2	C,D	1,2	1
13.	Selection Of Air Conditioning Apparatus For Cooling And De Humidification, Evaporative Cooling	2	C,D	1,2	1,3
	Unit IV: Refrigerant	**6**			
14.	Classification Of Refrigerants, Selection Of Refrigerants	2	C	1,4	1
15.	Desirable Properties Of Refrigerant, Containers Handling Refrigerants	2	C	1,4	1
16.	Tapping Into The Refrigerant Container	1	C	1,4	1
17.	Ambient Conditions Affecting System Pressures	1	C,D	1,4	1,4
	Unit V: Fans and Air Distribution	**9**			
18.	Fan Characteristics, Types Of Fans – Centrifugal Fans , Axial Fans	2	C	5	1
19.	Fan Arrangements – Indoor Air Distribution – Total, Static And Velocity Pressures	3	C,D	5	1
20.	Friction Loss In Duct, Dynamic Loss In Ducts, Air Flow Through Simple Duct System	4	C,D	5	1
21.	Cycle test-I	1			

22.	Cycle test-II	2			
23.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	C. P. Arora "*Refrigeration and Air conditioning*" – McGraw Hill Education (India) Private Limited, New Delhi
2.	William H. Crouse and Donald I. Anglin - "*Automotive Air conditioning*" - McGraw Hill, 1983
	Reference Books/Other Reading Material
3.	Paul Weiser - "*Automotive Air Conditioning*" - Reston Publishing Co., Inc., - 1990
4.	MacDonald, K.I., "*Automotive Air Conditioning*" - Theodore Audel series - 1978

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE362E	**Design of Automotive Thermal Systems**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE204						
Data Book / Codes/Standards	Psychometric chart, Heat and Mass transfer data book, Refrigerant table						
Course Category	P	Professional Electives	Engine				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	Obtain the knowledge to design different automobile thermal systems by applying the concepts of heat and mass transfer						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1.	Understand various thermal systems and its functions	a					
2.	Solve cooling load calculations and to select different types of fans.		b			e	h
3.	Understand various types of compressors		b	c	d		
4.	Familiarize with the applications of different fluid systems.	a					
5.	Understand the concepts to design heat exchangers	a	b	c	d	e	

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Introduction to Thermal Systems	**5**			
1.	System, boundary and surroundings, heat transfer, fluid flow	1	C	1	1,2
2.	Heat engines – Functions, components, working	2	C	1	1,2
3.	Cooling , properties of coolant, coolant recirculation and lubrication systems	2	C	1	1,2
	Unit II: Automotive Air Conditioing	**9**			
4.	Psychrometric properties, Use of psychrometric chart	2	C	1,2	2,3
5.	Refrigerants – Types of refrigerants, Properties and Selection of refrigerants	2	C	1,2	2,3
6.	Factors affecting the air flow, types of fans – Axial and Centrifugal fans	2	C,D	1,2	2,3
7.	Load calculations	2	C,D	1,2	2,3
8.	Winter air conditioning	1	C	1	2,3
	Unit III: Air Compressors	**9**			
9.	Types and classification of compressors, working principle	2	C	1,3	1,4,5
10.	Reciprocating compressors – single and multistage compressors - compression with and without clearance	3	C	1,3	1,4,5
11.	Calculations - volumetric, isothermal and isentropic efficiency, Rotary compressors	2	C,D	1,3	1,4,5

12.	Comparison between reciprocating and rotary compressors, Comparison between centrifugal and axial compressors	2	C	1,3	1,4,5
	Unit IV: Fluid Transport	**9**			
13.	Incompressibility and expansion of fluids, Transmission of forces through fluids, multiplication of forces Fluid power, Applications of fluid power – power brakes, power steering, shock absorber	3	C	1,3	1,6
14.	Components of hydraulic and pneumatic systems – Reservoir, pumps, strainers, filters, valve types, actuators, motors, accumulators, oil coolers, cooling fan, tubing, piping, hose	3	C	1,3	1,6
15.	Fluid transport and power systems, applications of pneumatic and hydraulic systems, advantage and disadvantages of systems	3	C	1,3	1,6
	Unit V: Heat Exchangers	**9**			
16.	Functions of radiator, compressor, condenser, evaporator, expansion valve	3	C	1,4	1,3,5
17.	Classification of heat exchangers – According to transfer process, number of fluids, surface compactness, construction features, flow arrangements, heat transfer mechanisms.	3	C	1,4	1,3,5
18.	Selection and design of heat exchangers based on – Types, heat transfer rate, cost, pumping power, size and weight, materials	2	C,D	1,4	1,3,5
19.	Basic thermal design theory for reciprocators	1	C	1,4	6
20.	Cycle test-I	1			
21.	Cycle test-II	2			
22.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Rajput R.K, "*Thermal Engineering*", Laxmi Publications, 8th Edition, New Delhi, 2010
2.	Dr. R. C. Sachdeva, "*Fundamentals of Engineering Heat and Mass Transfer*", New Age Science Ltd., New Delhi, 2009
3.	C.P Arora "*Refrigeration and Air conditioning*", 3rd edition., McGraw Hill Education (india) private Limited.2014
	Reference Books/Other Reading Material
4.	Holman, J P, "*Heat transfer*", McGraw – Hill, New york, 1968
5.	Yunus A Cengel, Afshin J Ghajar, "*Heat and Mass Transfer*"., Tat McGraw Hill Education Private Limited, New Delhi,2013
6.	Andrew parr, "*Hydraulics and Pneumatics*"., second edition, Butterworth Heinemann

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE363E	**Engine Testing and Validation**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Elective	Engine			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To impart knowledge on various engine parameters and its measurements, measurement systems, requirement of engine testing facility and importance of data validation							
Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able to								
1.	Understand the different parameters and its influence on performance of I.C engine	a		c		e	f	

2.	Measurement of different parameters	a		c		e	f	
3.	To acquire a fundamental knowledge on the instrumentations used	a		c	d	e	f	
4.	Gain insight on the fundamental considerations for engine test facility	a		c		e	f	k
5.	Acquire knowledge to validate the test results.	a	b	c	d	e	f	k

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
1	**Unit I: Performance Parameters**	**8**			
2	Power and Mechanical Efficiency	2	C	1	1
3	Mean Effective Pressure –Torque Output	2	C	1	1
4	Volumetric Efficiency- Fuel-air Ratio-Specific Fuel Consumption	2	C	1	1
5	Brake Thermal Efficiency and Heat Balance	2	C	1	1
	Unit II: Basic Parameters and its Measurements	**9**			
8	Brake power, indicated power and frictional power measurements	1	C,D	2	1,3
9	Dynamometers and types	2	C	2	1,3
10	Measurement of speed, fuel consumption measurement	2	C	2	1,3
11	Measurement of air consumption, measurement of exhaust smoke	2	C	2	1,3
12	Measurement of exhaust emissions	2	C	2	1,3
	Unit III: Instrumentations and Data Acquisition	**9**			
13	Pressure measurement ,The Hall-effect, Shielded-field sensor	1	C,D	3	1,3
14	Optical crankshaft position sensor, throttle angle sensor	2	C,D	3	1,3
15	Temperature Sensors, Typical Coolant Sensor, Sensors for Feedback Control	2	C,D	3	1,3
16	Exhaust Gas Oxygen Sensor, Desirable EGO characteristics, Switching characteristics, Knock Sensors	2	C,D	3	1,3
17	Data Acquisition: Data collection and control systems (EDACS), post processing of data	2	C,D	3	1,3
	Unit IV: Test Facility Layout and Considerations-Fundamentals	**8**			
19	Test cell - thermodynamic system, basics of test cell and control room design	2	C,D	4	2,3
20	Ventilation and air conditioning, vibration and noise	2	C,D	4	2,3
21	Cooling circuit and exhaust gas systems	2	C,D	4	2,3
22	Electrical systems considerations	1	C,D	4	2,3
23	Fuel storage, supply and treatment	1	C,D	4	2,3
	Unit V:Validation of Data and Test Results	**7**			
24	General principles for data validation in engine testing-error-types and sources	2	C	5	1,4
25	Combination of errors, repeatability-sensitivity- precision	2	C	5	1,4
26	Absolute and relative accuracy, traceability	1	C	5	1,4
27	Uncertainty- calibration –definition, importance and techniques (pressure, temperature) – gaussian distribution as a statistical tool.	2	C	5	1,4
28	Cycle test-I	1			
29	Cycle test-II	2			
30	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	"*Engine Testing and Theory and Practice*". , 2007,3rd edition A.J.Martyr, M.A. Plint,-SAE International
	Reference Books/Other Reading Material
2.	Ker-Wilson.W "*Vibration Engineering*" , Griffin ,London.1959

3.	Freeston,H.G. "*Test Bed installations and engine test equipment*" ,Proc.I.Mech.E.,172(7) .1958
4.	Dietrich,C.F. "*Uncertainty, Calibration and Probability*", Adam Hilger, London.1973

Course nature				**Theory**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE364E	**Advanced Engine Technology**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Engine				
Course designed by	Department of Automobile engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	Purpose of this course is to impart knowledge about SI engine, CI engine, Fuel injection system and recent trends on IC engines.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Acquire knowledge Thermodynamic Analysis of SI Engine Combustion process.	a	h		
2.	Acquire knowledge Thermodynamic Analysis of CI Engine Combustion process.	a	h		
3.	Understand the Various Fuel injection system for SI & CI engine	a	h		
4.	Gain knowledge about the engine modification required for alternative fuels.	a	h		
5.	Acquire knowledge about recent trends in IC engines.	a	h		

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I: Spark Ignition Engines	**8**			
1	Air-Fuel Ratio Requirements, Design Of Carburetor –Fuel Jet Size And Venture Size	2	C	1	1, 2,3,4
2	Stages Of Combustion-Normal And Abnormal Combustion, Factors Affecting Knock, Combustion Chambers	3	C	1	1, 2,3,4
3	Introduction To Thermodynamic Analysis Of SI Engine Combustion Process, Recent Developments In SI Engines	3	C	1	1, 2,3,4
	Unit II: Compression Ignition Engines	**9**			
4	Stages Of Combustion-Normal And Abnormal Combustion – Factors Affecting Knock	3	C	2	1, 2,3,4
5	Direct And Indirect Injection Systems, Combustion Chambers, Turbo Charging	3	C	2	1, 2,3,4
6	Introduction To Thermodynamic Analysis Of CI Engine Combustion Process, Recent Developments In CI Engines.	3	C	2	1, 2,3,4
	Unit III: Fuel Injection System	**8**			
7	Petrol Injection - Open Loop And Closed Loop Systems, Mono Point, Multi Point And Direct Injection Systems, Functions And Components.	2	C	3	1,2,3,4
8	In-Line, Rotary Pumps- Testing-Governing- Injection Lag . Fuel Injector - Types Of Injection Nozzle – Spray Characteristics	2	C	3	1,2,3,4
9	Injection Timing - Factors Influencing Fuel Spray Atomization, Penetration And Dispersion Of Diesel	2	C	3	1,2,3,4
10	Electronic Engine Management, Common Rail Direct Injection Diesel Engine	2	C	3	1,2,3,4
	Unit IV: Engine Modifications for Alternative Fuels	**8**			
11	Alcohols, Vegetable Oils And Bio-Diesel, Bio-Gas, Natural	4	C	4	2,3,4

	Gas, Liquefied Petroleum Gas, Hydrogen, Properties , Suitability				
12	Engine Modifications, Performance, Combustion And Emission Characteristics Of SI And CI Engines Using These Alternate Fuels	4	C	4	2,3,4
	Unit V: Recent Trends	**8**			
13	Homogeneous Charge Compression Ignition Engine	2	C	5	1,6
14	Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine	2	C	5	1,6
15	Four Valve And Overhead Cam Engines, Alternative Power Sources: Wankel Rotary Engine	2	C	5	1,6
16	Sterling Engine, Gas Turbine Engine	2	C	5	1,6
17	Cycle test-I	1			
18	Cycle test-II	2			
19	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Book**
1	Heinz Heisler, "*Advanced Engine Technology*"., SAE International Publications, USA,1998
2	Ganesan V. "*Internal Combustion Engines*"., Third Edition, Tata Mcgraw-Hill ,2007
	Reference Books
3	John B Heywood. "*Internal Combustion Engine Fundamentals*"., Tata McGraw-Hill 1988
4	Patterson D.J. and Henein N.A,"*Emissions from combustion engines and their control*"., Ann Arbor Science publishers Inc, USA, 1978
5	Gupta H.N, "*Fundamentals of Internal Combustion Engines*". ,Prentice Hall of India, 2006
6	Ultrich Adler , "*Automotive Electric / Electronic Systems*"., Published by Robert Bosh GmbH,1995

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE461E	**Simulation of IC Engines**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE303						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Engine				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire the knowledge about I.C engines simulation					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand combustion phenomena and measurements of URP and HRP	a	c	e	f	
2.	simulate SI engine Air flow	a	c	e	f	
3.	Acquire knowledge about pressure crank angle and engine performance	a	c	e	f	
4.	understand simulation of two stroke SI engine Performance	a	c	e	f	
5.	Gain knowledge about Diesel engine performance and Simulation	a	c	e	f	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction to Combustion	**8**			
1.	Introduction - Heat of reaction - Measurement of URP	1	C	1	1,2
2.	Measurement of HRP - Adiabatic flame temperature	2	C,D	1	1,2
3.	Complete combustion in C/H/O/N Systems	2	C	1	1,2
4.	Constant volume adiabatic combustion, constant pressure diabatic combustion. Calculation of adiabatic flame emperature - Isentropic changes of state.	3	C,D	1	1,2
	Unit II:SI Engine Simulation With Air as Working Medium	**8**			
5.	Deviation Between Actual And Ideal Cycle – Problems	1	C	1,2	1
6.	SI Engine Simulation With Adiabatic Combustion.	2	C,D	1,2	1
7.	SI Engine Temperature Drop Due To Fuel Vaporization, Full Throttle Operation - Efficiency Calculation	2	C,D	1,2	1
8.	SI Engine Part-Throttle Operation, Super Charged Operation.	3	C,D	1,2	1
	Unit III: Progressive Combustion	**8**			
9.	SI Engines Simulation With Progressive Combustion With Gas Exchange Process	1	C	1,3	1
10.	Heat Transfer Process, Friction Calculation	2	C,D	1,3	1
11.	Compression Of Simulated Values, Validation Of The Computer Code, Engine Performance Simulation.	2	C,D	1,3	1
12.	Pressure Crank Angle Diagram And Other Engine Performance.	3	C,D	1,3	1
	Unit IV: Simulation of 2-Stroke SI Engine	**8**			
13.	Simulate The Performance Of 2 Stroke SI Engine	4	C,D	1,4	1
14.	Simulation Of Unbalanced Forces On Two Stroke Engine	4	C,D	1,4	1
	Unit V: Diesel Engine Simulation	**9**			
15.	Multi Zone Model For Diesel Combustion	1	C,D	1,5	2
16.	Different Heat Transfer Models For Diesel Engine Simulation	3	C,D	1,5	2
17.	Diesel Engine Equilibrium Calculations, Simulation Of Engine Performance	3	C,D	1,5	2
18.	Diesel Engine Simulation For Pollution Estimation.	2	C,D	1,5	2
19.	Cycle test-I	1			
20.	Cycle test-II	2			
21.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Ganesan. V. "*Computer Simulation of spark ignition engine process*"., Universities Press (I) Ltd, Hyderbad, 1996.
	Reference Books/Other Reading Material
2.	Ganesan.V, "*Computer Simulation of Compression Ignition Engines*"., Orient Longman, 2000.
3.	Ramoss. A. L, "*Modelling of Internal Combustion Engines Processes*"., McGraw Hill Publishing Co., 1992.
4.	Ashley Campbel, "*Thermodynamic Analysis of Combustion Engines*"., John Wiley & Sons, New York, 986.
5.	Benson. R. S, Whitehouse. N. D., "*Internal Combustion Engines"*., Pergamon Press, Oxford, 1979.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE462E	Automotive Emission Formation and Controls			L	T	P	C
				3	0	0	3
Co-requisite:	NIL						
Prerequisite:	15AE303						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Engine				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire knowledge about Emission formation and controls in automobiles.					
Instructional Objectives		**Student Outcomes**				
At the end of the course, student will be able to						
1.	Understand the current scenario of Automobile Emissions and standards.	a		c	f	h
2.	Gain knowledge about the formation of Emissions from SI Engines.	a		c	f	h
3.	Gain knowledge about the formation of Emissions from CI Engines.	a			f	h
4.	Understand Emission and control Techniques in SI and CI Engines.	a	b	c	f	h
5.	Understand measuring techniques of Emission and test procedure.	a	b	c	f	h

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Emissions and Standards	**8**			
1.	Vehicle Population Assessment In Metropolitan Cities And Contribution To Pollution.	1	C	1	1
2.	Effects On Human Health And Environment, Global Warming.	2	C	1	1
3.	Types Of Emission, Transient Operational Effects On Pollution.	3	C	1	1
4.	Emission Standards, Driving Cycles - USA, Japan, Euro And India.	2	C	1	1
	Unit II: Emission Formation in SI Engines	**8**			
5.	Pollutant Formation In SI Engines.	1	C	1,2	1,2,3,4
6.	Mechanism Of HC And CO Formation In Four Stroke And Two Stroke SI Engines.	2	C	1,2	1,2,3,4
7.	Nox Formation In SI Engines, Effects Of Design And Operating Variables On Emission Formation, Control Of Evaporative Emission.	2	C	1,2	1,2,3,4
8.	Two Stroke Engine Emissions.	3	C	1,2	1,2,3,4,6
	Unit III: Emission Formation in CI Engines	**8**			
9.	Pollutant Formation In CI Engines.	1	C	1,3	1,2,3,4
10.	Smoke And Particulate Emissions In CI Engines.	1	C	1,3	1,2,3,4
11.	Effects Of Design And Operating Variables On CI Engine Emissions.	2	C	1,3	1,2,3,4
12.	NOx Formation And Control	2	C	1,3	1,2,3,4
13.	Noise Pollution From Automobiles, Measurement And Standards.	2	C	1,3	1,2,3,4
	Unit IV: Control of Emissions From SI and CI Engines	**8**			
14.	Design Of Engine, Optimum Selection Of Operating Variables For Control Of Emissions	1	C,D	1,4	1,2,4
15.	EGR, SCR, Thermal Reactors, Secondary Air Injection, Water Injection.	2	C	1,4	1,2,4
16.	After Treatment: Catalytic Converters, Catalysts, CO_2 Emission Reduction.	2	C	1,4	1,2,4
17.	Diesel Particulate Filter, NOx Versus Smoke –Trade Off, Fuel Modifications, Two Stroke Engine Emission Control.	3	C	1,4	1,2,4
	Unit V: Measurement Techniques Emission Standards and Test Procedure	**9**			
18.	Orsat Apparatus, NDIR.	1	C	1,5	1
19.	FID, Chemiluminescent analyzers.	3	C	1,5	1

20.	Gas Chromatograph, smoke meters.	3	C	1,5	1
21.	Test procedures - ECE, FTP Tests. SHED Test -chassis dynamometers, dilution tunnels.	2	C	1,5	1
22.	Cycle test-I	1			
23.	Cycle test-II	2			
24.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Books**
1.	Ganesan V, *"Internal combustion engines".*, 4th edition, Tata McGraw Hill Education, 2012.
	Reference Books/Other Reading Material
2.	Paul Degobert, "*Automobiles and Pollution".*, SAE International ISBN-1-56091-563-3, 1991
3.	John B Heywood. "*Internal Combustion Engine Fundamentals*". , Tata McGraw-Hill 1988.
4.	SAE Transactions "*Vehicle Emission".,* 1982 (3 volumes).
5.	Obert.E.F. "*Internal Combustion Engines".,* 1988.
6.	Marco Nute "*Emissions from two stroke engines".*, SAE Publication-1998.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE463E	**Fuel Testing and Standards**			**L**	**T**	**P**	**C**
				3	**0**	**0**	**3**
Co-requisite:	NIL						
Prerequisite:	15AE303						
Data Book / Codes/Standards	NIL						
Course Category	P	Professional Elective	Engines				
Course designed by	Department of Automobile Engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	To acquire knowledge on the fuel testing procedures ,standards and its importance							
Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able to								
1.	The different types of fuels used in automotive industry and importance of fuel testing	a			e	f	h	j
2.	Regulations and different Standards , A retrospection of fuel quality improvement and related amendments	a			e	f	h	j
3.	Properties of fuels influencing IC engine performance	a	b	d	e	f	h	
4.	Property testing methods for gasoline and diesel	a		d	e	f	h	
5.	Property testing methods for biodiesels, CNG and LPG	a			e	f	h	

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit I:Automotive Fuels	**9**			
1.	Petroleum, Diesel, CNG- sources and composition	1	C	1	1,2
2.	LPG, Alcohol and biodiesels –sources and composition	2	C	1	1,2
3.	Reformulated fuels and additives-Types and Use	2	C	1	1,2
4.	Importance of fuel testing – An overview of the different standards available for fuel testing-EN, ASTM, ISO, JIS BIS	2	C	1,2	1,2
	Unit II: Reference and Commercial Fuels	**8**			
5.	Technical Specification Of Reference Fuel For Testing Vehicles -Gasoline, Diesel, CNG, LPG	2	C	2	2,3,6
6.	Comparison Of The Specification Of Commercial Gasoline And Commercial Diesel For Different Bharat Stage Norms,	2	C	2	2,3,6
7.	Fuel Quality Improvement Accomplished In India, Fuel Quality Compliance Issues- Fuel Testing, Presumptive Liability, Fuel Registration And Tracking-A Comparison In	2	C	2	2,3,6

	India, USA And Japan				
8.	Inhibiting Factors In Fuel Quality Improvement In India	2		2	2,3,6
	Unit III: Fuel Properties	**8**			
9.	Properties Of Different Fuels-Volatility, Oxidation Stability, Octane And Cetane Rating,	2	C	3	1,3
10.	Calorific Value, Density, Viscosity, Carbon Residue Etc	2	C	3	1,3
11.	Characteristic Requirements Of Different Fuels In IC Engines- Availability, Fuel Economy And Performance	2	C	3	1,3
12.	Gasoline Quality Effects On Vehicle Emissions, Diesel Quality Effects On Vehicle Emissions-Ultra Low Sulphur Fuels	2	C	3	1,3
	Unit IV: Commercial Gasoline and Diesel Fuel Testing as Specified In BIS	**8**			
13.	Method to determine Distillation temperatures, Research Octane Number (RON), Motor Octane Number (MON),	1	C	4	1,3
14.	Calorific value, Oxidation Stability, Sulphur content, Reid Vapour Pressure, Benzene, Aromatic Olefin and oxygen content	2	C	4	1,3
15.	Method to determine Ash content, Carbon residue, Cetane number and Index	2	C	4	1,3
16.	Distillation temperature, Flash point, Kinematic viscosity, density, calorific value	1	C	4	1,3
17.	Test for sulphur and water content, Cold filter plug point, Copper strip corrosion, Oxidative stability, Polycyclic Aromatic Hydrocarbon	2	C	4	1,3
	Unit V: CNG,LPG and Biodiesels Testing as Specifies in BIS	**8**			
18.	Method to determine methane and Ethane content, C_3 and C_4 content, Motor Octane Number, Hydrogen sulphide content(LPG), Odour, Copper strip corrosion and Wobbe Index(CNG)	2	C	5	4,5,6
19.	Odour, Copper strip corrosion and Wobbe Index(CNG)	1	C	5	4,5,6
20.	Oxidation Stability, Low temperature flow properties, Kinematic viscosity	2	C	5	4,5,6
21.	Cetane number, Copper strip corrosion, Ester content, Mono, Di and Tri-glycerides	2	C	5	4,5,6
22.	Density, Iodine Number, Structure indices.	1	C	5	4,5,6
23.	Cycle test-I	1			
24.	Cycle test-II	2			
25.	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
	Reference Books/Other Reading Material
1.	Keith owen, trevor coley "*automotive fuels reference book*"., , second edition, sae inc.,1995
2.	"*Motor vehicles act*". ,2009,India
3.	ARAI Tap Document "*Document on Test Method, Testing Equipments and Related Procedures for Testing Type approval and Conformity of Production (COP)*".,Ministry of Road Transport and High ways
4.	Amit Sarin "*Biodiesel Production and Properties* "., , RSC Publishing ,2012
5.	Sajid Zaman "*Practical Handbook on Fuel Properties and Testing*"., Lambert Academic Publishing,2014
6.	S.S. Thipse "*Alternative fuels concepts technologies and developments*"., ,Jaico Publishing House

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AE464E	Automotive Exhaust System Development	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	15AE303				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Elective	Engine			
Course designed by	Department of Automobile Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

Purpose	To Acquire Knowledge About The Exhaust System Development of an automotive						
Instructional Objectives		**Student Outcomes**					
At the end of the course, student will be able to							
1	Understand the History and evolution of Automobile Exhaust System	a	c	e	f	h	k
2	Gain familiarity on the emission norms and emission reduction techniques	a	c	e	f	h	k
3	Get familiarized with the basics of acoustics, muffler types and characteristic design of mufflers	a	c	e	f	h	k
4	Understand the procedures and fundamentals involved in computational fluid dynamic, thermal and structural analysis of vehicle exhaust system	a	c	e	f	h	k
5	Understand the fundamentals involved in testing and validation of automotive exhaust system	a	c	e	f	h	k

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: History of Automobile Exhaust Systems	**5**			
1	History and evolution of automobile exhaust system	1	C	1	1,2
2	Basics of exhaust system from engine head face to tail pipe– layout of exhaust system –components of exhaust system.	1	C	1	1,2
3	Air pollution and noise control requirements in automobiles	1	C	1	1,2
4	Hot end components –cold end components –manufacturing of exhaust components–system integration	2	C	1	1,2
	Unit II: Hot End	**9**			
5	Gasoline and diesel engine out pollutants – emission norms – air to air – converter hot end components	1	C	1,2	1,2
6	Twc– manifold – cone profiles – substrate – types of substrate – wash coat – mat – types of mats – shell	1	C	1,2	1,2
7	Canning – types of canning – controlled canning –gbd (gab bulk density)	1	C	1,2	1,2
8	Temperature sensor – oxygen sensor – thermal management – insulators – heat shields – (gasoline \ diesel)	2	C	1,2	1,2
9	Advancement in substrates –technology for gasoline engine–three way converter (twc) –gasoline particulate filter(gpf)	1	C	1,2	1,2
10	Lean nox trap (lnt) –technology for diesel engine –exhaust gas recirculation (egr)	1	C	1,2	1,2
11	Diesel oxidation catalyst (doc) –partial flow filter (pff) – diesel particulate filter (dpf) –selective catalytic reduction (scr) – selective catalytic reduction filter (scrf) –global regulations and testing protocols	2		1,2	1,2
	Unit III: Cold End	**9**			
12	Basics of acoustics–fundamentals of sound –terminologies–noise cancellation– destructive & constructive interferences	1	C,D	3	2
13	Engine noise introduction–gasoline & diesel engine operation. Exhaust noise characteristics –vehicle pass by noise – exhaust noise measurement standards	1	C,D	3	2
14	Types of exhaust noises– pulsation noises–flow noises–booming noises–shell radiation noises–passive noise reduction techniques	1	C,D	3	2
15	Types of mufflers –reflective–absorptive –hybrid mufflers – muffler design constrains–muffler internal design–tri flow muffler	1	C,D	3	2

	–straight though muffler				
16	Helmholtz resonator – internal resonators –baffle plates– perforations –shells –end plates–pipe diameters	1	C,D	3	2
17	Absorptive materials –development methodologies – muffler performance parameters– sound transmission loss –insertion loss	1	C,D	3	2
18	Noise reduction–tail pipe noise level –back pressure –vehicle interior noise levels–advanced muffler technologies–cat con integrated muffler	1	C,D	3	2
19	Variable flow muffler –twin mufflers–active noise cancellation– sporty sound mufflers–sound engineering, off road – on road –non road muffler applications examples –manufacturing types & process	1	,D	3	2
20	Roll and spot welding–lock seaming–double seaming –web forming–clinching–cold metal transfer–hydro forming –piercing– stamping–muffler examples	1	C,D	3	2
	Unit IV: Computational Analysis (CFD and FEA)	**9**			
21	CFD for vehicle exhaust system – governing equation of fluid flow and heat transfer – flow uniformity – pressure loss through exhaust system	1	C,D	4	1,2
22	Exhaust system – flow eccentricity – hego index – conjugate heat transfer analysis– introduction to finite element analysis..	2	C,D	4	1,2
23	Present, past, future fea– introduction to preprocessing 1d, 2d, 3d elements– meshing and processing techniques.	2	C,D	4	1,2
24	Statics of strength of materials– types of analysis– modal analysis– linear static analysis.	2	C,D	4	1,2
25	Introduction to non-linear analysis–dynamic analysis–thermal analysis– rlda & fatigue analysis – post processing techniques of different analysis – process flows and targets – case study 1-2-3.	2	C,D	4	1,2
	Unit V:Testing and Validation	**9**			
26	Vehicle noise measurement - operational vibration analysis – experimental modal analysis – air leak test – thermal shock tests – thermal fatigue test	1	C,D	5	1,2
27	Back pressure measurement test–hot end system :hot vibration test – cold vibration test – flow noise measurement	2	C,D	5	1,2
28	Shell deformation test–cold end: biaxial fatigue test – uniaxial fatigue test–salt spray test – condensate water noise test	2	C,D	5	1,2
29	Transmission loss measurement – shell stiffness measurement – glass wool endurance test	2	C,D	5	1,2
30	Resonance frequency measurement – shell radiation noise measurement – tail pipe noise measurement – water drainage ability test.	2	C,D	5	1,2
31	Cycle test-I	1			
32	Cycle test-II	2			
33	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**REFERENCE BOOKS**
1	Philip ii smith and John Morrison "*The scientific design of exhaust and intake systems engineering and performance*"., 3rd edition, publisher : Bentley (Robert) inc., us
2	Istvan l. Ver and leo l.Beranek "*Noise and vibration control engineering (principles and applications)*"., 2nd edition 2006, publisher : john wiley & sons inc.
3	M.lmunjal "*Acoustics of ducts and mufflers with applications to exhaust and ventilation system design*"., 2nd edition, publisher : wiley- inter science

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AE465E	Engine Auxiliary Systems			L	T	P	C
				3	0	0	3
Co-requisite:	NIL						
Prerequisite:	15AE303						
Data Book / Codes/Standards	NIL						
Course Category	P	PROFESSIONAL ELECTIVE	ENGINE				
Course designed by	Department of Automobile engineering						
Approval	32nd Academic Council Meeting , 23rd July 2016						

Purpose	Purpose of this course is to impart knowledge about Super charging & Turbocharging their mapping procedure and thermodynamic issues related to their operation.				
Instructional Objectives		**Student Outcomes**			
At the end of the course, student will be able to					
1.	Acquire knowledge about Supercharging and compressor mapping.	a	c		
2.	Gain knowledge about Flow maps of supercharging systems.	a	c		
3.	Analyze Thermodynamic issues with Turbocharging.	a	c		
4.	Understand the Modern design features of exhaust turbocharger features.	a	c		
5.	Acquire knowledge about Engine thermal management.	a	c		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Super Charging & Compressor Mapping	**8**			
1.	Definitions, survey of supercharging methods, petrol engines, diesel engines, exhaust turbocharging.	2	C	1	1,7
2	Fundamentals of compressor matching, compressor power, air consumption, types and characteristics of compressors.	3	C	1	1,7
3	Relationship between air consumption and power. Volumetric efficiency of supercharged four stroke engines. Computations of gas exchange process	3	C	1	1,7
	Unit II: Flow Maps of Supercharging Systems	**8**			
4	Two and four stroke engines, interaction between turbocharger and engine.	2	C	2	1,2
5	Mechanical supercharging, exhaust turbo charging and operational differences. Equivalent nozzle area of turbine	3	C	2	1,2
6	Pulse turbocharging and diagram for determination of operating condition of a single stage turbocharger system. Examples of computed results	3	C	2	1,2
	Unit III: Thermodynamic Issues with Turbocharging	**8**			
7	Cylinder release temperature and mean exhaust temperature, theoretical aspects of complete extraction of work by expanding from release pressure to ambient pressure.	2	C	3	1,2
8	Complete conversion into kinetic energy at ambient pressure.	2	C	3	1,2
9	Compressor power in terms of mean piston pressure, difference in fuel consumption between mechanical and exhaust superchargers.	2	C	3	1,2
10	Effect of cooling the charge air. Exhaust turbocharger as a means to increase efficiency.	2	C	3	1,2
	Unit IV:Particular Features of Exhaust Turbocharging	**8**			
11	Exhaust manifold arrangements for various firing sequences of engines. Constant pressure vs pulse turbocharging.	2	C	4	1,2
12	Modified forms of pulse turbocharging. Transient response. Torque characteristics of engines with exhaust turbochargers.	2		4	1,2
13	Measures to improve acceleration and torque characteristics of exhaust turbocharged engines.	2	C	4	1,2
14	Altitude de-rating. Effect of supercharging on exhaust emissions of ci and si engines.	2	C	4	1,2

	Unit V:Modern Design Features of Exhaust Turbocharger Features and Engine Thermal Management	**9**			
15	Charge boosting, exhaust pre-release, turbo-cooling, miller, two stage, comprex, hyperbar, rotor designs	2	C	5	1,2,6
16	Types of impellers, bearing arrangements, types and lubrication on bearings	1	C	5	1,2,6
17	Examples of supercharged engines of road vehicles (cases), introduction to engine cooling systems, engine coolants, heat exchangers, in-vehicle installation, performance curves.	2	C	5	1,2,6
18	Pressurized engine cooling systems: filling, de- aeration & drawdown, accessories. On-highway cooling system test code, engine cooling systems field test (air-to-boil), heat exchanger thermal & pressure cycle durability. Cooling fans: fan laws, fan characteristics, and system resistance curve	2	C	5	1,2,6
19	Cooling flow measurement techniques. Cooling system inspection, trouble diagnosis & service. Radiator field failures. Introduction to egr (exhaust gas recirculation) coolers & its significance in reduction of vehicle emissions.	2	C	5	1,2,6
20	Cycle test-I	1			
21	Cycle test-II	2			
22	Surprise test	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Book**
1	Zinner, K, "*Auxillary Engine Systems by Supercharging of Internal Combustion Engines*"., Springer, 1978.
	Reference Books
2	N. Watson and M.S. Janota, "*Turbocharging the Internal Combustion Engines*", Macmillan Press, London 1982
3	BOSCH, "*Automotive Handbook*", 8 th Edition, Bentley Robert Incorporated, 2011
4	Lilly, L.C.R, "*Diesel Engine Reference Book*", Butterworths, London, 1984
5	Benson, R.S, Whitehouse N.D, "*Internal Combustion Engines*", Vol 1 and 2, Pergamon Press Ltd. Oxford UK.1980
6	Tom Birch, "*Automotive Heating & Air Conditioning*", 6th edition, Prentice Hall PTR, 2011
7	Hermann Hiereth, Peter Prenninger, "*Charging the Internal Combustion Engine*", Springer, 2010.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**