

# **K.L.N. COLLEGE OF ENGINEERING**

**Pottapalayam-630612, Sivagangai District**

**(An Autonomous Institution, Affiliated to Anna University, Chennai)**



**Estd: 1994**

## **CURRICULUM AND SYLLABUS**

**I to VIII Semesters**

**REGULATIONS 2020**

**For under Graduate Program**

## **B.E. AUTOMOBILE ENGINEERING**

**CHOICE BASED CREDIT SYSTEM**

**(For the students admitted in the academic year 2020-2021)**



**K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM**  
(An Autonomous Institution, Affiliated to Anna University, Chennai)



### **VISION OF THE INSTITUTION**

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society.

### **MISSION OF THE INSTITUTION**

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry.

### **VISION OF THE DEPARTMENT**

To be an Academic Centre for Quality Education, Innovation and Constructive Resources for the Automotive Industry and Society.

### **MISSION OF THE DEPARTMENT**

To offer State-of-the-art Undergraduate Programme in Automobile Discipline to fulfill Industrial Requirements Globally by Imparting Innovative Knowledge, Ethical values and Collaborative Projects.



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### **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

**PEO1** Will have applied their engineering skills in solving contemporary issues of analyzing, designing and evaluating automobile engineering problems.

**PEO2** Will have engaged in solving technical and social problems with their creative skills, interdisciplinary and collaborative approach with good communication skills.

**PEO3** Will have ethically practiced their profession with leadership qualities to tackle business challenges.

**PEO4** Will have involved in sustained learning to adapt themselves in continuously changing and challenging environment through self and professional studies.

### **PROGRAM SPECIFIC OUTCOMES (PSOs)**

**PSO 1** Apply mathematics, science, and computing techniques in a comprehensive method to solve automobile engineering problems in the areas of Vehicle design, Vehicle dynamics, automotive electronics and Power train problems.

**PSO 2** Use modern modeling and simulation techniques with acquired cross-discipline knowledge and industrial engineering concepts to develop strategies for solving automobile engineering problems in the current work environment.

**PSO 3** Assess society needs and develop constructive and creative solutions for complex automobile engineering problems under social and ethical constraints.



**PO1: Engineering Knowledge**

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

**PO2: Problem Analysis**

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/Development of Solutions**

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct Investigations of Complex Problems**

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern Tool Usage**

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6: The Engineer and Society**

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and Sustainability**

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8: Ethics**

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and Team Work**

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: Communication**

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11: Project Management and Finance**

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12: Life-Long Learning**

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.



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**REGULATIONS 2020**  
**For Under Graduate Program**  
**B.E. – AUTOMOBILE ENGINEERING**  
**CHOICE BASED CREDIT SYSTEM**

**CATEGORY OF COURSES**

- i. **Humanities and Social Sciences (HS) Courses** include Technical English, Environmental Science and Engineering, Engineering Ethics and human values, Communication Skills and Management courses.
- ii. **Basic Sciences (BS) Courses** include Mathematics, Physics, and Chemistry.
- iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering / Instrumentation etc.
- iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.
- v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.
- vi. **Open Elective (OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. / B.Tech. Programmes.
- vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.
- viii. **Mandatory (MC) Courses** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc



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**REGULATIONS 2020**  
**CHOICE BASED CREDIT SYSTEM**  
**B.E. AUTOMOBILE ENGINEERING**  
**CURRICULUM AND SYLLABUS**  
**I TO VIII SEMESTERS**

**SEMESTER I**  
**(Common to all B.E/B.Tech Programmes)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20HS101	English for Technical Communication	HS	3	3	0	0	3
2.	20BS101	Fundamentals of Engineering Mathematics	BS	4	3	1	0	4
3.	20BS102	Engineering Physics	BS	3	3	0	0	3
4.	20BS103	Engineering Chemistry	BS	3	3	0	0	3
5.	20GE101	Problem Solving using Python Programming	ES	3	3	0	0	3
<b>PRACTICAL</b>								
6.	20BS1L1	Basic Science Laboratory	BS	3	0	0	3	1.5
7.	20GE1L1	Python Programming Laboratory	ES	4	0	0	4	2
8.	20GE1L2	Industrial Practices Workshop	ES	3	0	0	3	1.5
<b>TOTAL</b>				<b>26</b>	<b>15</b>	<b>1</b>	<b>10</b>	<b>21</b>

## SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20HS201	Advanced Technical Communication <b>(Common to all B.E./B.Tech programmes)</b>	HS	3	3	0	0	3
2.	20BS201	Laplace Transform and Advanced Calculus <b>(Common to all B.E./B.Tech programmes)</b>	BS	4	3	1	0	4
3.	20BS202	Applied Physics (Common to B.E Mech & B.E Au.Engg))	BS	3	3	0	0	3
4.	20GE201	Engineering Graphics <b>(Common to all B.E./B.Tech programmes)</b>	ES	4	2	0	2	3
5.	20GE202	Engineering Mechanics <b>(Common to B.E Mech &amp; B.E Au.Engg)</b>	ES	4	3	1	0	4
6.	20GE203	Basic Electrical, Electronics and Instrumentation Engineering <b>(Common to B.E. Mech &amp; B.E Au.Engg)</b>	ES	3	3	0	0	3
<b>PRACTICAL</b>								
7.	20HS2L1	Communication Skills Laboratory <b>(Common to B.E Mech, B.E AUE, B.E CSE &amp; B.Tech IT programmes)</b>	HS	2	0	0	2	1
8.	20GE2L1	Electrical, Electronics and Instrumentation Laboratory <b>(Common to B.E Mech &amp; B.E Au.Engg)</b>	ES	4	0	0	4	2
<b>TOTAL</b>				<b>27</b>	<b>17</b>	<b>2</b>	<b>8</b>	<b>23</b>

**SEMESTER III**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20BS301	Transforms and Partial Differential Equations (Common to Mech,EEE & AUE programmes)	BS	4	3	1	0	4
2.	20ME301	Strength of Materials	ES*	3	3	0	0	3
3.	20ME302	Fluid Mechanics and Machinery	ES*	3	3	0	0	3
4.	20AE301	Applied Thermodynamics	PC	3	3	0	0	3
5.	20AE302	Automotive Engines	PC	3	3	0	0	3
6.	20HS301	Universal Human Values (Common to all B.E./B.Tech. programmes)	HS	3	2	1	0	3
<b>PRACTICAL</b>								
7.	20ME3L1	Strength of Materials Laboratory	ES*	3	0	0	3	1.5
8.	20ME3L2	Fluid Mechanics and Machinery Laboratory	ES*	3	0	0	3	1.5
9.	20AE3L1	Machine Drawing	PC	4	0	0	4	2
<b>TOTAL</b>				<b>29</b>	<b>17</b>	<b>2</b>	<b>10</b>	<b>24</b>

**SEMESTER IV**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20BS401	Statistics and Numerical Methods	BS*	4	3	1	0	4
2.	20HS401	Environmental Science and Engineering (Common to all B.E./B.Tech. programmes)	HS	2	2	0	0	2
3.	20AE401	Mechanics of Machines	PC	3	3	0	0	3
4.	20AE402	Automotive Chassis and Transmission	PC	3	3	0	0	3
5.	20AE403	Engineering Metallurgy	PC	3	3	0	0	3
6.	20AE404	Manufacturing Processes and Technology	PC	3	3	0	0	3
<b>THEORY CUM PRACTICAL</b>								
7.	20EC406	Fundamentals of Automotive Electronics	ES	4	2	0	2	3
<b>PRACTICAL</b>								
8.	20AE4L1	Automotive Systems Laboratory	PC	3	0	0	3	1.5
9.	20ME4L1	Manufacturing Technology Laboratory (Common to B.E Mech & B.E Au.Engg programmes)	PC	3	0	0	3	1.5
<b>TOTAL</b>				<b>28</b>	<b>19</b>	<b>1</b>	<b>8</b>	<b>24</b>

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**SEMESTER V**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20ME501	Design of Machine Elements (Common to B.E Mech & B.E Au.Engg)	PC*	4	3	1	0	4
2.	20AE501	Automotive Electrical and Electronics	PC	3	3	0	0	3
3.	20AE502	Vehicle Design Data and Characteristics	PC	3	3	0	0	3
4.	20AE503	Electric Vehicles	PC	3	3	0	0	3
5.		Open Elective - 1	OE	3	3	0	0	3
6.	20MC501	Constitution of India (Common to all B.E./B.Tech. programmes)	MC	1	1	0	0	0
<b>THEORY CUM PRACTICAL</b>								
7.	20AE504	Automotive Fuels and Lubricants	PC	4	2	0	2	3
<b>PRACTICAL</b>								
8.	20AE5L1	Automotive Electrical and Electronics Laboratory	PC	4	0	0	4	2
9.	20HS4L2	Professional Communication Laboratory (Common to B.E EEE, B.E Au.Engg & B.E. EIE programmes)	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>27</b>	<b>18</b>	<b>1</b>	<b>8</b>	<b>22</b>

**SEMESTER VI**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20AE601	Design of Automotive Engine Components	PC	3	3	0	0	3
2.	20AE602	Design of Automotive Chassis Components	PC	3	3	0	0	3
3.	20AE603	Metrology and Quality Control	PC	3	3	0	0	3
4.	20ME602	Finite Element Analysis (Common to B.E Mech & B.E Au.Engg)	PC*	3	3	0	0	3
5.		Professional Elective - 1	PE	3	3	0	0	3
6.	20MC601	Essence of Indian Traditional Knowledge (Common to all B.E./B.Tech. programmes)	MC	1	1	0	0	0
<b>THEORY CUM PRACTICAL</b>								
7.	20AE604	Two and Three Wheelers	PC	4	2	0	2	3
<b>PRACTICAL</b>								
8.	20AE6L1	Computer Aided Vehicle Design Laboratory	PC	4	0	0	4	2
9.	20AE6L2	Innovation Practices Laboratory	EEC	4	0	0	4	2
<b>TOTAL</b>				<b>28</b>	<b>18</b>	<b>0</b>	<b>10</b>	<b>22</b>

\* Common to B.E Mech &amp; B.E Au.Engg programmes

**SEMESTER VII**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20AE701	Intelligent Vehicle Technology	PC	3	3	0	0	3
2.	20AE702	Vehicle Dynamics	PC	3	3	0	0	3
3.		Open Elective - 2	OE	3	3	0	0	3
4.		Professional Elective - 2	PE	3	3	0	0	3
5.		Professional Elective - 3	PE	3	3	0	0	3
<b>PRACTICAL</b>								
6.	20AE7L1	Engine Testing Laboratory	PC	4	0	0	4	2
7.	20AE7L2	Vehicle Trouble Shooting Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>23</b>	<b>15</b>	<b>0</b>	<b>8</b>	<b>19</b>

**SEMESTER VIII**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20AE801	Vehicle Body Engineering	PC	3	3	0	0	3
2.		Professional Elective - 4	PE	3	3	0	0	3
<b>PRACTICAL</b>								
3.	20AE8L1	Project Work	EEC	20	0	0	20	10
<b>TOTAL</b>				<b>26</b>	<b>6</b>	<b>0</b>	<b>20</b>	<b>16</b>

**TOTAL NO. OF CREDITS: 171****PROFESSIONAL ELECTIVES (PE)  
SEMESTER VI****ELECTIVE I**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20AE6A1	Advanced Theory of IC Engines	PE	3	3	0	0	3
2.	20AE6A2	Fundamentals of Combustion	PE	3	3	0	0	3
3.	20AE6A3	Hybrid and Fuel Cell Vehicles	PE	3	3	0	0	3
4.	20AE6A4	Robotics	PE	3	3	0	0	3
5.	20AE6A5	Non Destructive Testing	PE	3	3	0	0	3
6.	20AE6A6	Solar and Wind Energy Technology	PE	3	3	0	0	3

**SEMESTER VII****ELECTIVE II**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20AE7A1	Automotive Heating Ventilation and Air-conditioning	PE	3	3	0	0	3
2.	20AE7A2	Off Road Vehicles	PE	3	3	0	0	3
3.	20AE7A3	Noise, Vibration and Harness	PE	3	3	0	0	3
4.	20AE7A4	Engine and Vehicle Management Systems	PE	3	3	0	0	3
5.	20AE7A5	Vehicle Maintenance	PE	3	3	0	0	3
6.	20AE7A6	Alternative Fuels and Energy Systems	PE	3	3	0	0	3

**SEMESTER VII****ELECTIVE III**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20AE7B1	Lean Methods For Automobile Engineers	PE	3	3	0	0	3
2.	20HS6A1	Intellectual Property Rights	PE	3	3	0	0	3
3.	20HS7A2	Total Quality Management	PE	3	3	0	0	3
4.	20HS601	Operations Research	PE	3	3	0	0	3
5.	20HS6A2	Entrepreneurship Development	PE	3	3	0	0	3
6.	20HS602	Principles of Management	PE	3	3	0	0	3

**SEMESTER VIII****ELECTIVE IV**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20AE8A1	Transport Management	PE	3	3	0	0	3
2.	20AE8A2	Automotive Safety	PE	3	3	0	0	3
3.	20AE8A3	Automotive Pollution and Control	PE	3	3	0	0	3
4.	20AE8A4	Automotive Testing	PE	3	3	0	0	3
5.	20AE8A5	Regulatory Mechanism for Transportation Systems	PE	3	3	0	0	3
6.	20ME7A2	Computer Integrated Manufacturing Systems	PE	3	3	0	0	3

**OPEN ELECTIVES - I (OE- I)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE101	Mechatronics and Applications	OE	3	3	0	0	3
2.	20OE104	Production and Operations Management	OE	3	3	0	0	3
3.	20OE201	Fundamentals of Renewable Energy system	OE	3	3	0	0	3
4.	20OE301	Fundamentals of Communication Engineering	OE	3	3	0	0	3
5.	20OE402	Introduction to Database Management Systems	OE	3	3	0	0	3
6.	20OE403	Computer Communication Networks	OE	3	3	0	0	3
7.	20OE502	Fundamental of Web Technology	OE	3	3	0	0	3
8.	20OE503	Internet of Things and Applications	OE	3	3	0	0	3
9.	20OE703	Energy Conversion Techniques	OE	3	3	0	0	3
10.	20OE704	Instrumentation in steel industry	OE	3	3	0	0	3

**OPEN ELECTIVES - II (OE- II)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE105	Solar Photovoltaic Fundamentals and Applications	OE	3	3	0	0	3
2.	20OE106	Fundamentals of Product Design	OE	3	3	0	0	3
3.	20OE108	Industrial Safety Practices	OE	3	3	0	0	3
4.	20OE205	Industrial Energy Auditing and Management	OE	3	3	0	0	3
5.	20OE208	Electrical Drives and Control for Automation	OE	3	3	0	0	3
6.	20OE405	Machine Learning Techniques	OE	3	3	0	0	3
7.	20OE406	Java Script Programming	OE	3	3	0	0	3
8.	20OE505	Information Security Essentials	OE	3	3	0	0	3
9.	20OE706	Industrial computer Networks	OE	3	3	0	0	3
10.	20OE708	Instrumentation for Agro-food processing industry	OE	3	3	0	0	3

**OPEN ELECTIVE – I (V SEMESTER) – offered to other Departments**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE601	Fundamental of Electric Vehicles	OE	3	3	0	0	3
2.	20OE602	Supply Chain Management	OE	3	3	0	0	3
3.	20OE603	Automotive Safety Systems	OE	3	3	0	0	3
4.	20OE604	Basics of Automobile Engineering	OE	3	3	0	0	3

**OPEN ELECTIVE – II (VII SEMESTER) – offered to other Departments**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE605	Lean Manufacturing Practices	OE	3	3	0	0	3
2.	20OE606	Modern Vehicle Technology	OE	3	3	0	0	3
3.	20OE607	New Generation Hybrid Vehicles	OE	3	3	0	0	3
4.	20OE608	Automotive Electrical and Electronics Systems	OE	3	3	0	0	3

**HUMANITIES AND SOCIAL SCIENCES (HS)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20HS101	English for Technical Communication	HS	3	3	0	0	3
2.	20HS201	Advanced Technical Communication	HS	3	3	0	0	3
3.	20HS2L1	Communication Skills Laboratory (Common to B.E Mech, B.E AUE, B.E CSE & B.Tech IT programmes)	HS	2	0	0	2	1
4.	20HS301	Universal Human Values	HS	3	2	1	0	3
5.	20HS401	Environmental Science and Engineering	HS	2	2	0	0	2
<b>Total credits (HS)</b>								<b>12</b>

**BASIC SCIENCES (BS)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20BS101	Fundamentals of Engineering Mathematics	BS	4	3	1	0	4
2.	20BS102	Engineering Physics	BS	3	3	0	0	3
3.	20BS103	Engineering Chemistry	BS	3	3	0	0	3
4.	20BS1L1	Basic Science Laboratory	BS	3	0	0	3	1.5
5.	20BS201	Laplace Transform and Advanced Calculus	BS	4	3	1	0	4
6.	20BS202	Applied Physics	BS	3	3	0	0	3
7.	20BS301	Transforms and Partial Differential Equations	BS	4	3	1	0	4
8.	20BS401	Statistics and Numerical Methods	BS	4	3	1	0	4
<b>Total credits (BS)</b>								<b>26.5</b>

**PROFESSIONAL CORE (PC)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20AE301	Applied Thermodynamics	PC	3	3	0	0	3
2.	20AE302	Automotive Engines	PC	3	3	0	0	3
3.	20AE3L1	Machine Drawing	PC	4	0	0	2	2
4.	20AE401	Mechanics of Machines	PC	3	3	0	0	3
5.	20AE402	Automotive Chassis and Transmission	PC	3	3	0	0	3
6.	20AE403	Engineering Metallurgy	PC	3	3	0	0	3
7.	20AE404	Manufacturing Processes and Technology	PC	3	3	0	0	3
8.	20AE4L1	Automotive Systems Laboratory	PC	3	0	0	3	1.5
9.	20ME4L1	Manufacturing Technology Laboratory	ES	3	0	0	3	1.5
10.	20ME501	Design of Machine Elements	PC	4	4	1	0	4
11.	20AE501	Automotive Electrical and Electronics	PC	3	3	0	0	3
12.	20AE502	Vehicle Design Data and Characteristics	PC	3	3	0	0	3
13.	20AE503	Electric Vehicles	PC	3	3	0	0	3
14.	20AE504	Automotive Fuels and Lubricants (Theory cum Practical)	PC	4	2	0	2	3
15.	20AE5L1	Automotive Electrical and Electronics Laboratory	PC	4	0	0	4	2
16.	20ME602	Finite Element Analysis	PC	3	3	0	0	3
17.	20AE601	Design of Automotive Engine Components	PC	3	3	0	0	3
18.	20AE602	Design of Automotive Chassis Components	PC	3	3	0	0	3
19.	20AE603	Metrology and Quality Control	PC	3	3	0	0	3
20.	20AE604	Two and Three Wheelers (Theory cum Practical)	PC	4	2	0	2	3
21.	20AE6L1	Computer Aided Vehicle Design Laboratory	PC	4	0	0	4	2
22.	20AE701	Intelligent Vehicle Technology	PC	3	3	0	0	3
23.	20AE702	Vehicle Dynamics	PC	3	3	0	0	3
24.	20AE7L1	Engine Testing Laboratory	PC	4	0	0	4	2
25.	20AE7L2	Vehicle Trouble Shooting Laboratory	PC	4	0	0	4	2
26.	20AE801	Vehicle Body Engineering	PC	3	3	0	0	3
<b>Total credits (PC)</b>								<b>71</b>

ENGINEERING SCIENCES (ES)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20GE101	Problem Solving using Python Programming	ES	3	3	0	0	3
2.	20GE1L1	Python Programming Laboratory	ES	4	0	0	4	2
3.	20GE1L2	Industrial Practices workshop	ES	3	0	0	3	1.5
4.	20GE201	Engineering Graphics	ES	4	2	0	2	3
5.	20GE202	Engineering Mechanics	ES	4	3	1	0	4
6.	20GE203	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
7.	20GE2L1	Electrical, Electronics and Instrumentation Laboratory	ES	4	0	0	4	2
8.	20ME301	Strength of Materials	ES	3	3	0	0	3
9.	20ME302	Fluid Mechanics and Machinery	ES	3	3	0	0	3
10.	20ME3L1	Strength of Materials Laboratory	ES	3	0	0	3	1.5
11.	20ME3L2	Fluid Mechanics and Machinery Laboratory	ES	3	0	0	3	1.5
12.	20EC406	Fundamentals of Automotive Electronics	ES	4	2	0	2	3
<b>Total credits (ES)</b>								<b>30.5</b>

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20HS4L2	Professional Communication Laboratory	EEC	2	0	0	2	1
2.	20AE6L2	Innovation Practices Laboratory	EEC	4	0	0	4	2
3.	20AE8L1	Project Work	EEC	20	0	0	20	10
<b>Total credits (EEC)</b>								<b>13</b>

MANTATORY COURSES (MC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MC501	Constitution of India	MC	1	1	0	0	-
2.	20MC601	Essence of Indian Traditional knowledge	MC	1	1	0	0	-

## SUMMARY

S. No.	CATEGORY	NUMBER OF CREDITS									
		I SEM	II SEM	III SEM	IV SEM	V SEM	VI SEM	VII SEM	VIII SEM	TOTAL CREDITS	Credit %
1	Humanities and Social Sciences (HS)	3	4	3	2		-	-	-	12	7.02
2	Basic Sciences (BS)	11.5	7	4	4	-	-	-	-	26.5	15.50
3	Engineering Sciences (ES)	6.5	12	9	4.5	-	-	-	-	30.5	17.84
4	Employability Enhancement Course (EEC)	-	-	-	-	1	2	-	10	13	7.60
5	Professional Core (PC)	-	-	8	13.5	18	17	10	3	71	41.52
6	Professional Electives (PE)	-	-	-	-	-	3	6	3	12	7.02
7	Open Electives (OE)	-	-	-	-	3	-	3	-	6	3.51
8	Mandatory Courses (MC)	-	-	-	-	-	-	-	-	-	-
<b>Credits per semester</b>		21	23	24	24	22	22	19	16	171	
<b>Credits per year</b>		44		48		44		35		171	
<b>TOTAL CREDITS</b>										171	

<b>20HS101</b>	<b>ENGLISH FOR TECHNICAL COMMUNICATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- This course is designed for entry level Engineering and Technology curriculum enabling the students to learn, acquire and apply for their learning and career.
- The course is aimed at providing effective skills for promoting communication skills through English.
- Students will benefit in conversing with the peers, faculty and fellow professionals.
- The outcome of this course contains refined level of English proficiency by acquiring all four skills, listening, speaking, reading and writing to prepare them for global readiness.

**PRE-REQUISITE: NIL****UNIT-I FOCUSING LANGUAGE DEVELOPMENT 9**

**Listening:** Listening to TV News, Guest Lecturers, Note – taking. **Speaking:** Pronunciation Common Vocabulary – Technical Vocabulary – Answering Peer Questions – Conversation with Teacher. **Reading:** News magazines, Reading for unfamiliar words, Variety of News Items

**Writing:** Word formation – Auxiliary verbs – Modal Verbs – Sentence Types – Affirmative, Negative, Interrogative, Concord – Dialogue Writing, Letter to Principal / Director – Instructions using Auxiliary

**UNIT-II GRAMMAR AND TECHNICAL READING 9**

**Listening:** Listening to Peer Conversations – Brief Speeches – Listening for Specific Information – Recap of Speeches. **Speaking:** Wh Questions, Day today conversations, Telephonic enquiries official/formal enquiries. **Reading:** Technical Essays – Identifying Sentence Types – Classifying the verb patterns. **Writing:** Tenses – Simple Present, Present Progressive, Present Perfect, Present Perfect Continuous – Voice – Active & Passive – Précis Writing – Essay Writing

**UNIT - III GRAMMAR AND LANGUAGE DEVELOPMENT 9**

**Listening:** TV interviews, Commentaries, Digital Videos for World Information. **Speaking:** Telephonic Conversation – Classroom Activities – Conversing Information. **Reading:** Coherence, Development of Thoughts. **Writing:** Tenses – Simple Past, Past Progressive, Past Perfect, Past perfect continuous – Impersonal Passive-Narrating the past events, Letter to friend/father about Industrial Visit/Functions held – Narrating the past experience using Impersonal Passive voice

**UNIT - IV READING AND LANGUAGE DEVELOPMENT 9**

**Listening:** Listening to Dialects of English – British & American Regional. **Speaking:** Role Plays, Extempore, Responding to specific questions. **Reading:** Comprehensive passages, Reading for specific points. **Writing:** Tenses – Simple Future, Future progressive, Future Perfect, Future Perfect continuous – Definition – Phrases of Reason – Cause & Effect, Recommendations, Argumentative Essays, Letter to the Editor on Social Issues – Analytical Essays on Social hazards using Cause and Effect.

**UNIT - V EXTENDED WRITING 9**

**Listening:** Listening to Technical Seminar speeches – Listening to achievers, eminent personalities – Dialects – Australian – African – Asian. **Speaking:** Welcome address, Compeering, Vote of Thanks, Peer debates. **Reading:** Texts on self-confidence, motivation, success path. **Writing:** Contracted forms, Conditionals, Articles, Preposition, Tense – ‘going to’ - Error Spotting, Sequence Words – Rearranging – Writing a Book Review – Summary writing – Rearranging Sentences using Sequence Words, Note Making

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Board of Editors. Using English “A Course book for Undergraduate Engineers and Technologists”. Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack. “Interchange Students’ Book-2” New Delhi: CUP, 2015

**REFERENCES:**

1. Murphy, Raymond “English Grammar in Use with Answers: Reference and Practice for Intermediate Students”, Cambridge: CUP, 2004
2. Thomson, A.J. and Martinet, A.V. “A Practical English Grammar”, OUP, New Delhi: 1986  
Anne Laws, Writing Skillsll, “Orient Black Swan”, Hyderabad, 2011
3. Board of Editor, “English for Technical Communication”, Great Mind Publication, Chennai : 2018

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : English for Technical Communication										Course Code : 20HS101					
CO	Course Outcomes									Unit	K-CO	POs	PSOs		
C101.1	Listen, Comprehend and Correspond with others at various contexts									I-V	AD	9,10,12	3		
C101.2	Speak legibly and fluently under various life-time situations by applying proper communication modules									I-V	AD	9,10,12	3		
C101.3	Read and understand a variety of writings and technical text by analyzing the meaning and language									I-V	AD	9,10,12	3		
C101.4	Apply clear and legible writing skills in error free style in coherent manner									I-V	AD	9,10,12	3		
C101.5	Remember and use various communicative skills in precise and efficient way on technological contexts									I-V	AD	9,10,12	3		
C101.6	Form situational conversations and technical writing styles for interpersonal and effective communication									I-V	AD	9,10,12	3		
CO-PO mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C101.1	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1
C101.2	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1
C101.3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	1
C101.4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	1
C101.5	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1
C101.6	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1

<b>20BS101</b>	<b>FUNDAMENTALS OF ENGINEERING MATHEMATICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**OBJECTIVES:**

- To relate various methods of Matrix Algebra to handle practical problems arising in the field of engineering.
- The main aim of this course is to achieve conceptual understanding and to retain the best traditions of Calculus.
- The syllabus is designed to provide the basic tools of Calculus of Single and Multivariable, mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.

**PRE-REQUISITE: NIL****UNIT-I MATRICES 12**

Introduction to Matrices-Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a Quadratic form to Canonical form by Orthogonal transformation – Nature of Quadratic forms.

**UNIT-II DIFFERENTIAL CALCULUS 12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Differentiation of Polynomials, Exponential, Trigonometric, Hyperbolic, Logarithmic and Implicit functions- Maxima and Minima of functions of single variable.

**UNIT - III FUNCTIONS OF SEVERAL VARIABLES 12**

Partial differentiation – Homogeneous functions and Euler’s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables – Maxima and Minima of functions of two variables – Lagrange’s method of undetermined multipliers

**UNIT - IV INTEGRAL CALCULUS 9**

Definite and Indefinite integrals - Substitution rule - Techniques of integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions, Improper integrals.

**UNIT - V ORDINARY DIFFERENTIAL EQUATIONS 9**

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2017.
2. T. Veerarajan., “Engineering Mathematics I”, The Tata Mc Graw Hill Publication-New Delhi, First Edition, 2018

**REFERENCES:**

1. James Stewart, “Calculus, Early Transcendental”, Cengage Learning, 7<sup>th</sup> Edition, New Delhi, 2015. [For units II & III].
2. Kreyszig Erwin, “Advanced Engineering Mathematics”, John Wiley and Sons, 9<sup>th</sup> Edition, New Delhi, 2006.
3. Wiley, “Calculus- International Student version”, 10<sup>th</sup> Edition, Wiley India Pvt. Ltd, New Delhi 2017.
4. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5<sup>th</sup> Edition, 2016.
5. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics II”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 9<sup>th</sup> Edition, 2014.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : FUNDAMENTALS OF ENGINEERING MATHEMATICS								Course Code : 20BS101						
CO	Course Outcomes								Unit	K-CO	POs	PSOs		
C102.1	Determine the Eigen values, Eigen vectors to diagonalize a matrix and reduce quadratic form to canonical form.								I	K3	1,2,3,8,9	1		
C102.2	Apply the concept of limits, continuity, rules of differentiation techniques of differentiation to differentiate standard functions.								II	K3	1,2,3,8,9			
C102.3	Apply the concepts of Concavity, Convexity to determine the critical points, point of Inflection, Maxima and Minima of Single variable functions.								II	K3	1,2,3,8,9	1		
C102.4	Compute the derivatives of functions of two variables and apply them to calculate the maxima and minima.								III	K3	1,2,3,8,9	1		
C102.5	Determine integrals using techniques of integration, such as substitution, partial fractions and integration by parts.								IV	K3	1,2,3,8,9	1		
C102.6	Apply various techniques to solve higher order differential equations with constant and variable Coefficients.								V	K3	1,2,3,8,9	1		
CO-PO mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C102.1	3	2	1	-	-	-	-	1	1	-	-	-	2	-
C102.2	3	2	1	-	-	-	-	1	1	-	-	-	2	-
C102.3	3	2	1	-	-	-	-	1	1	-	-	-	2	-
C102.4	3	2	1	-	-	-	-	1	1	-	-	-	2	-
C102.5	3	2	1	-	-	-	-	1	1	-	-	-	2	-
C102.6	3	2	1	-	-	-	-	1	1	-	-	-	2	-

<b>20BS102</b>	<b>ENGINEERING PHYSICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To inculcate the fundamental knowledge in properties of matter and crystal physics.
- To enrich the knowledge on Laser, fiber optics and ultrasonics and their applications relevant to various streams of Engineering and Technology.
- To introduce quantum physics and its applications

**PRE-REQUISITE: NIL****UNIT-I PROPERTIES OF MATTER 9**

Elasticity – Hooke’s Law – Stress-strain diagram and its uses – Three modulus of elasticity (qualitative) – Poisson’s ratio – factors affecting elastic modulus and tensile strength – twisting couple – torsional pendulum: theory and experiment – bending of beams – bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – I-shaped girders.

**UNIT-II LASER AND FIBER OPTICS 9**

Lasers: Interaction of radiation with atomic energy states – Einstein’s A and B coefficients derivation – Population inversion – resonant cavity, optical amplification (qualitative) – solid state lasers – Nd:YAG laser, Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode) – losses associated with optical fibers – fiber optic sensors: pressure and displacement sensor.

**UNIT - III ULTRASONICS 9**

Ultrasonics – classification (qualitative) – properties – generation – magnetostriction and piezoelectric methods – detection of ultrasound – cavitations – velocity measurement – acoustic grating – Industrial applications (Drilling, Welding, Soldering and Cleaning) – SONAR – NDT – Pulse Echo system through Transmission and Reflection modes – A, B and C scan displays - Medical application – sonogram.

**UNIT - IV QUANTUM PHYSICS 9**

Black body radiation – Planck’s theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – wave function and its physical significance – Schrödinger’s wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunneling (qualitative) – scanning tunneling microscope.

**UNIT - V CRYSTAL PHYSICS 9**

Crystalline and amorphous materials – unit cell, crystal systems, Bravais lattices, lattice planes - Miller indices – Inter planar spacing in cubic lattice – coordination number and packing factor for SC, BCC, FCC, HCP structures – growth of single crystals: solution and melt growth techniques – Mechanisms of plastic deformation, slip and twinning.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. R. K. Gaur and S. L. Gupta, “Engineering Physics”, Dhanpat Rai Publications, 2012.
2. B. K. Pandey and S. Chaturvedi, “Engineering Physics”, Cengage Learning India, 2018.
3. V.Rajendran, “Engineering Physics”, Tata McGraw Hill Education Private Limited, 2011.

**REFERENCES:**

1. D.Halliday, R. Resnick and J. Walker, “Principles of Physics”, Wiley publisher, 10<sup>th</sup> Edition, 2015.
2. R.A.Serway and J.W. Jewett, “Physics for Scientists and Engineers”, Cengage Learning, 2014.
3. P.A.Tipler and G. Mosca, “Physics for Scientists and Engineers with Modern Physics”, W.H.Freeman, 2007.
4. D.K.Bhattacharya and T. Poonam, “Engineering Physics”, Oxford University Press, 2017.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ENGINEERING PHYSICS		Course Code: 20BS102			
CO	Course Outcomes	Unit	K-CO	POs	PSOs
C103.1	Demonstrate the properties of elasticity and measure the different moduli of elasticity	1	K3	1, 2, 3	1
C103.2	Discuss the characteristics of laser and optical fiber	2	K2	1, 2, 8,9,10	1
C103.3	Explain the concepts of ultrasonics in engineering	3	K2	1, 2, 8,9,10	1
C103.4	Explain black body radiation, properties of matter waves and Schrodinger equation	4	K2	1, 2, 8,9,10	2
C103.5	Classify the Bravais lattices and different types of crystal structures	5	K3	1, 2, 3	2
C103.6	Summarize the information on growth of crystals and deformations	5	K2	1, 2, 8,9,10	2

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C103.1	3	2	1										1	
C103.2	2	1						1	1	1			1	
C103.3	2	1						1	1	1			1	
C103.4	2	1						1	1	1				1
C103.5	3	2	1											1
C103.6	2	1						1	1	1				1

<b>20BS103</b>	<b>ENGINEERING CHEMISTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To make the students, familiar with boiler feed water requirements, related problems and water treatment techniques.
- To learn the principle of electrochemical cell, types of corrosion and its control.
- To develop an understanding of the basic concepts of phase rule and its applications to one and two component systems and appreciate the purpose and significance of alloys.
- To be familiar with different types of fuel and their characteristics and also functioning of energy storage devices.
- To understand the techniques of spectra and chromatography for analytical purpose.

**PRE-REQUISITE: NIL****UNIT-I WATER AND ITS TREATMENT 9**

Characteristics of water; Hard water, Soft water, difference; Hardness – types of hardness, expression of hardness, units, removal of hardness (boiling, soda lime process), estimation of hardness of water by EDTA method (problems); Boiler feed water – requirements – disadvantages of using hard water in boilers (scale and sludge, priming and foaming, caustic embrittlement, boiler corrosion); Treatment of boiler feed water – internal treatment (carbonate, phosphate, and calgon conditioning) external treatment – ion exchange process, zeolite process; Purification of water - reverse osmosis, electro dialysis, Application of nanomaterials in water purification.

**UNIT-II ELECTROCHEMISTRY AND CORROSION 9**

Electrochemical cell - redox reaction, electrode potential- origin of electrode potential- oxidation potential-reduction potential, - electrochemical series and its significance - Nernst equation (derivation and problems).

Corrosion- causes- factors, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method – corrosion inhibitors. Metallic coating – Electroplating – Factors - Electroplating of Copper and Electroless plating of Nickel.

**UNIT - III PHASE RULE AND ALLOYS 9**

Phase rule - introduction, definition of terms with examples; One component system - water system; Reduced phase rule - two component system, classification, lead-silver system; Alloys – introduction, definition, properties of alloys, significance of alloying; Functions and effects of alloying elements; Heat treatment of steel - annealing, hardening, tempering, carburizing, nitriding; Ferrous alloys- nichrome and stainless steel (18/8); Non-ferrous alloys – brass and bronze.

**UNIT - IV FUELS AND BATTERIES 9**

Fuels – classification, characteristics; Petrol – characteristics, knocking, octane number; Diesel – characteristics, cetane number; Natural gas (CNG), LPG, Power alcohol, Biodiesel, Gasohol; Combustion of fuels – calorific value, GCV and NCV (Problems), calculation of theoretical air for combustion (Problems), Ignition temperature, explosive range, flue gas analysis (Orsat apparatus); Batteries – primary and secondary batteries, lead-acid battery, lithium ion battery, Fuel cell (hydrogen oxygen fuel cell).

**UNIT - V ANALYTICAL TECHNIQUES 9**

Spectroscopic techniques – UV-visible (Principle and Instrumentation – Block Diagram only and applications), IR(Principle and Instrumentation – Block Diagram only and applications), <sup>1</sup>H NMR ((Principle and Instrumentation – Block Diagram only) – Chromatography – HPLC - Flame photometry – Estimation of sodium by Flame photometry.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. P.C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2017
2. S.S Dara and S.S Umare, "A Text Book of Engineering Chemistry", S.Chand & Company Limited, 20th Edition, 2018

**REFERENCES:**

1. Shashi Chawla, "A Textbook of Engineering Chemistry", Dhanpat Rai & CO. (PVT) LTD, New Delhi, 2012.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal, "Principles of Physical Chemistry", Vishal Publishing Co., Punjab, 47<sup>th</sup> Edition, 2017.
3. G Palanna, "Engineering Chemistry", McGraw Hill Education (India) PVT, LTD, Chennai, 2017.
4. Dr. Sunita Rattan, "A Textbook of Engineering Chemistry", S.K.Kataria & Sons, New Delhi, 2012

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ENGINEERING CHEMISTRY										Course Code : 20BS103				
CO	Course Outcomes										Unit	K-CO	POs	PSOs
C104.1	Determine the hardness of water and explain the water treatment methods.										I	K2	1,2,6,7	1
C104.2	Apply Nernst equation to determine the EMF of the cell and explain various corrosion control methods.										II	K3	1,2,3,6,7	1
C104.3	Describe the phase diagram of one component and two component system and various methods of heat treatment of steel.										III	K2	1,2	1
C104.4	Classify the various types of fuels by their characteristics and explain the flue gas analysis by Orsat method.										IV	K2	1,2,6,7	1
C104.5	Illustrate the working of Lead acid battery, lithium ion battery and fuel cell.										IV	K2	1,2,6,7	1
C104.6	Describe the instrumentation and working of UV, IR, 1HNMR, HPLC and flame photometry.										V	K2	1,2	1
CO-PO mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C104.1	2	2	-	-	-	1	1	-	-	-	-	-	1	-
C104.2	3	2	1	-	-	1	1	-	-	-	-	-	1	-
C104.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C104.4	2	1	-	-	-	1	1	-	-	-	-	-	1	-
C104.5	2	1	-	-	-	1	1	-	-	-	-	-	1	-
C104.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-



**TEXT BOOKS:**

1. E. Balagurusamy, “Problem solving and Python Programming”, First edition, McGraw Hill Education (India) Private Limited, 2017.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2<sup>nd</sup> edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)

**REFERENCES:**

1. Yashavant Kanetkar, Aditya Kanetkar, “Let Us Python”, 2<sup>nd</sup> Edition, BPB Publications, 2020.
2. John V Guttag, “Introduction to Computation and Programming Using Python: With Application to Understanding Data”, 2<sup>nd</sup> Edition, PHI Publisher, 2017.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach”, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Paul Gries, “Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python 3.6”, 3<sup>rd</sup> edition, Shroff/O’ Reilly Publishers, 2018.  
Dr. A. Kannan, Dr. L. Sai Ramesh, “Problem Solving and Python Programming”, Updated Edition, United Global Publishers Pvt. Ltd., April 2018.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: Problem Solving using Python Programming											Course Code: 20GE101			
CO	Course Outcomes											Unit	K –CO	
C105.1	Explain Components of a Computer System, types of programming languages, types of software with examples and purpose.											1	K3	
C105.2	Perform problem analysis, use algorithms and prepare flow charts, pseudo code for solving simple problems.											1	K3	
C105.3	Use Conditional, iteration constructs of python programming and apply to solve simple problems											2	K3	
C105.4	Use Functions, recursive function, String functions in python programming and apply to perform linear and binary search											3	K3	
C105.5	Explain the various operations for manipulating Tuples, Dictionaries and Use List toper form simple and sorting operations											4	K3	
C105.6	Explain file handling operations, exception handling, modules and packages and illustrate programs for word count, file copy, merge operations and exception handling.											5	K3	
CO-PO Mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C105.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1
C105.2	2	1	-	-	-	-	-	-	-	-	-	-	2	1
C105.3	3	2	1	-	-	-	-	-	-	-	-	-	2	1
C105.4	3	2	1	-	-	-	-	-	-	-	-	-	2	1
C105.5	3	2	1	-	-	-	-	-	-	-	-	-	2	1
C105.6	3	2	1	-	-	-	-	-	-	-	-	-	2	1

20BS1L1

BASIC SCIENCE LABORATORY

L	T	P	C
0	0	3	1.5

## PHYSICS LABORATORY

## OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in Optics, properties of matter and liquids.

## PRE-REQUISITE: NIL

## LIST OF EXPERIMENTS

(Any five to be carried out &amp; one demonstration experiment)

- Determination of Rigidity modulus – Torsional Pendulum.
- Determination of Young's modulus – Non Uniform Bending.
- Determination of wavelength and particle size using diode laser.
  - Determination of acceptance angle in an optical fiber.
- Determination of velocity of sound and compressibility of liquid using ultrasonic interferometer.
- Determination of band gap of a semiconductor diode.
- Determination of thickness of a thin wire – Air wedge method.
- Determination of dispersive power of a prism – Spectrometer\*
- Determination of wavelength of mercury spectrum – Spectrometer grating

\*Demonstration experiment

## LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Torsional pendulum set	6
2	Travelling microscope & accessories	6
3	Laser kit	6
4	Ultrasonic interferometer	6
5	Semiconductor band gap kit	6
6	Air wedge set up	6
7	Spectrometer & prism	6
8	Spectrometer & Grating	6

**CHEMISTRY LABORATORY****OBJECTIVES:**

- To make the students to acquire practical skill in the determination of water quality parameters through volumetric analysis.
- To have hands on experience in using instruments like pH meter, conductivity meter, **potentiometer**.
- To acquaint the students with the determination of molecular weight of polymer by viscometer.

**PRE-REQUISITE: NIL****Any Five experiments to be given**

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of dissolved oxygen content of water sample by Winkler's method.
4. Determination of strength of given hydrochloric acid using pH meter.
5. Estimation of iron content of the given solution using potentiometer.
6. Conductometric titration of a strong acid Vs a strong base.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
9. Corrosion Experiment – Weight Loss Method.
10. Estimation of sodium present in water using flame photometer.

**TOTAL(Physics & Chemistry): 45 PERIODS****REFERENCE:**

1. Vogel's "Text book of quantitative chemical analysis" (8<sup>th</sup> edition, 2014)

**LIST OF APPARATUS AND EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	Burette	30
2	Pipette	30
3	Beaker (100ml)	30
4	Conical Flask (250ml)	30
5	Conductivity meter	10
6	Potentiometer	10
7	pH meter	10
8	Viscometer	10
9	Flame Photometer	1
10	Electronic Balance	1

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: BASIC SCIENCE LABORATORY										Course Code:20BS1L1				
CO	Course Outcomes									Exp	K	POs	PSOs	
<b>PHYSICS</b>														
C106.1	Calculate rigidity modulus and Young's modulus of a given material.									1,2	K3	1,2,3,8,9,10	1	
C106.2	Examine the size of a given particle, parameters of optical fiber and compute the thickness of a given thin wire.									3,6	K3	1,2,3,8,9,10	1	
C106.3	Discover the velocity of ultrasound, compressibility of a given liquid and band gap of a given semiconductor diode.									4,5	K3	1,2,3,8,9,10	1	
C106.4	Predict dispersive power of prism and wavelength of mercury spectrum.									7,8	K2	1,2,8,9,10	1	
<b>CHEMISTRY</b>														
C106.5	Estimate the Chemical quality parameter of a water sample.									1,2,3	K3	1,2,3,8,9,10	1	
C106.6	Estimate the strength of acid by conductometric and pH metric titration.									4,6,7	K3	1,2,3,8,9,10	1	
C106.7	Estimate the amount of iron content in a given solution using potentiometer and the amount of sodium in water using flame photometer.									5,10	K3	1,2,3,8,9,10	1	
C106.8	Determine the molecular weight of polyvinyl alcohol using Ostwald viscometer and rate of corrosion by weight loss method. (Demo)									8,9	K2	1,2	1	
<b>CO-PO Mapping</b>														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>PHYSICS</b>														
C106.1	3	2	1	-	-	-	-	1	1	1	-	-	1	-
C106.2	3	2	1	-	-	-	-	1	1	1	-	-	1	-
C106.3	3	2	1	-	-	-	-	1	1	1	-	-	1	-
C106.4	2	1	-	-	-	-	-	1	1	1	-	-	1	-
<b>CHEMISTRY</b>														
C106.5	3	2	1	-	-	-	-	1	1	1	-	-	1	-
C106.6	3	2	1	-	-	-	-	1	1	1	-	-	1	-
C106.7	3	2	1	-	-	-	-	1	1	1	-	-	1	-
C106.8	2	1	-	-	-	-	-	-	-	-	-	-	1	-



**20GE1L2****INDUSTRIAL PRACTICES WORKSHOP**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**OBJECTIVES:**

- To provide exposure to the students with Hands on Experience on various Basic Industrial Practices in Civil, Mechanical, Electrical and Electronics Engineerin

**PRE-REQUISITE: NIL****GROUP A (CIVIL & MECHANICAL)****LIST OF EXPERIMENTS****I CIVIL ENGINEERING PRACTICE****UNIT-I CARPENTRY PRACTICE**

- Study of carpentry tools.
- Preparation of Cross lap joint
- Preparation of Dovetail joint
- Preparation of T joint

Classification of welding processes – principles of Oxy-acetylene gas welding – A.C metal arc welding – submerged arc welding – tungsten inert gas welding – metal inert gas welding – resistance welding – thermit welding – plasma arc welding - electron beam welding – laser beam welding – defects in welding– Soldering and Brazing.

**UNIT-II PLUMBING PRACTICE**

- Study of plumbing tools, pipeline joints, its location and functions: valves, taps, couplings, unions, reducers and elbows in household fittings.
- Exercise on Preparation of plumbing line sketches for water supply and sewage works.
- Exercise on providing of basic water line connection for a residential house using plumbing components.
- Exercise on providing Water line pipe connections for household utilities like water heater, wash basin etc.,

**II MECHANICAL ENGINEERING PRACTICE****UNIT - III SHEET METAL PRACTICE**

- Study of sheet metal forming tools.
- Preparation of a Model of rectangular tray.
- Preparation of a Model of Conical Funnel.

**UNIT - IV MACHINING PRACTICE**

- Study of machining tools.
- Exercise on Simple turning, Facing, Chamfering
- Exercise on Taper turning.
- Exercise on Drilling and Tapping.

**UNIT - V METAL JOINING PROCESS**

- Study of welding tools.
- Exercise to join two metal plates by single butt joint using arc welding.
- Exercise to join two metal plates by T Fillet joint using arc welding.
- Exercise to join two metal plates by lap joint using arc welding.

**9****DEMONSTRATION**

- Gas welding process.
- Refrigeration and Air conditioning process.

**GROUP B (ELECTRICAL & ELECTRONICS)  
LIST OF EXPERIMENTS**

**I ELECTRICAL ENGINEERING PRACTICE**

1. Residential house wiring using switches, fuse, indicator, Fluorescent lamp and Energy Meter.
2. Measurement of Power consumption for CFL, Fluorescent Lamp, LED Lamp and Incandescent lamp.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

**II ELECTRONICS ENGINEERING PRACTICE**

1. Study of Electronic components – Resistor colour coding, Capacitor, Inductor- Measurement using LCR meter, Transistor & Diode – Terminal identification using Multimeter.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Measurement of AC signal parameter (peak-peak, rms value, period & frequency) using CRO and AFO.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

**TOTAL: 45 PERIODS**

<b>LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS</b>		
<b>CIVIL</b>		
<b>S.No</b>	<b>Component Name</b>	<b>No. of Components</b>
1	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, coupling, unions, elbows, plugs and other fittings	15 sets
2	Carpentry Vice (fitted to work bench)	15 nos
3	Standard wood working tools	15 sets
4	Models of industrial trusses, door joints, furniture joints	5 each
5	Power Tools a. Rotary Hammer b. Demolition Hammer c. Circular Saw d. Planer e. Hand Drilling Machine f. Jigsaw	2 nos 2 nos 2 nos 2 nos 2 nos 2 nos
<b>MECHANICAL</b>		
1	Arc welding transformer with cables and holders	5 nos
2	Welding booth with exhaust facility	5 nos
3	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 sets
4	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 nos
5	Centre Lathe	2 nos

6	Power Tool: Angle Grinder	2 nos
7	Study purpose items: Refrigerator and Air Conditioner	One each
<b>ELECTRICAL</b>		
1	Assorted electrical components for house wiring	10 sets
2	Electrical measuring instruments	10 sets
3	Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4	Megger (250V/500V)	1 no.
5	Power Tools a. Range Finder b. Digital Live-wire detector	2 nos 2 nos
<b>ELECTRONICS</b>		
1	Soldering guns	10 nos
2	Assorted electronic components for making circuits	50 nos
3	Small PCBs	10 nos
4	Multimeters	10 nos
5	Regulated of power supply, CRO	1 no. each

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

CourseName: INDUSTRIALPRACTICESWORKSHOP										Course Code: 20GE1L2						
CO	Course Outcomes											K	POs	PSO		
C108.1	Prepare different carpentry joints and pipe connections with different joints.											K3	1,2,3,4	1,2		
C108.2	Make the models using sheet metal.											K3	1,2,3,4	1,2		
C108.3	Carry out the basic machining operations.											K3	1,2,3,4	1,2		
C108.4	Prepare arc welded joints using welding equipment											K3	1,2,3,4	1,2		
C108.5	Demonstrate wiring for a simple residential house; identify the ratings of tube lamp, and calculate the different Electrical quantities											K3	1,2,3,4	1,2		
C108.6	Measure the electronics equipment using LCR meter, Transistor & Diode – Terminal identification using Multimeter.											K3	1,2,3,4	1,2		
C108.7	Experimentally to analyze AC signal parameters using CRO and AFO and to verify the Truth tables of Logic gates.											K3	1,2,3,4	1,2		
C108.8	Experimentally to design a Simple circuit using soldering in a PCB,measure ripple factor of Half Wave Rectifier and Full Wave Rectifier.											K3	1,2,3,4	1,2		
<b>CO-PO mapping</b>																
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3	
C108.1	3	1	1	1	-	-	-	-	-	-	-	-	1	2	2	
C108.2	3	1	1	1	-	-	-	-	-	-	-	-	1	2	2	
C108.3	3	1	1	1	-	-	-	-	-	-	-	-	1	2	2	
C108.4	3	2	1	1	-	-	-	-	-	-	-	-	1	2	2	
C108.5	3	2	1	1	-	-	2	-	2	2	-	-	1	2	2	
C108.6	3	2	1	1	-	-	2	-	2	2	-	-	1	2	2	
C108.7	3	2	1	1	-	-	2	-	2	2	-	-	1	2	2	
C108.8	3	2	1	1	-	-	2	-	2	2	-	-	1	2	2	

<b>20HS201</b>	<b>ADVANCED TECHNICAL COMMUNICATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- This course is designed for Engineering and Technology curriculum enabling the students to learn, acquire and apply updated elements of English communication.
- The course is aimed at providing effective skills for procuring communication skills for business and advanced technology.
- Students will benefit by learning the four skills – Listening, Speaking, Reading and Writing – to meet the global requirements for their career and higher studies.

**PRE-REQUISITE: NIL****UNIT-I TECHNICAL WRITING 9**

**Listening:** Listening to audio-visuals on personal Interviews, Speeches from Company CEOs, TV Debates.

**Speaking:** Wishing, Greeting, Enquiring Hobbies. **Reading:** Editorials, Letter to the Editor Columns, Technical Papers. **Writing:** Analytical writings, Emphasis Techniques, Letter Writing – Business Correspondence, Abstract Writing, Common Errors, Footnotes, Compound words, Preparation of Agenda

**UNIT-II BUSINESS ENGLISH AND LANGUAGE DEVELOPMENT 9**

**Listening:** Listening to Audio-Visual documentary, TV Programs of Celebrities Forum. **Speaking:** Self-Expression, Introducing the fellow students, Talking about celebrities, leaders

**Reading:** Company Correspondence, Business Correspondence, Technical Text for Vocabulary

**Writing:** Bibliography, Sentence Completion, Cloze exercises, Verbal Analogy, Letter – Business enquiry orders, payments, Minutes Preparation.

**UNIT - III VISUAL BASED LANGUAGE DEVELOPMENT 9**

**Listening:** Visuals on Group Discussion-Understanding the nuances of GD – Approach – Content – Methodology. **Speaking:** Discussing main points on burning issues, Social issues – Expressing ideas and suggestions. **Reading:** Etiquettes of Non-Verbal Communication.

**Writing:** List of common expressions for specified situations – Sentence linkers – Formal Expressions – Suggestions – Reported Speech - Letter to the Editor on Common Issues – Writing the Points in Indirect Form – Check Lists – Numerical Expression.

**UNIT - IV EMPLOYABILITY CORRESPONDENCE 9**

**Listening:** Listening to Visuals of Technical Paper presentation – Technical and HR interviews

**Speaking:** Peer-to-Peer Interview – Mock Interview – Telephone Conversations. **Reading:** Comparative Analyses – Instructions on Public Spots – Time Management concepts – Email Correspondence. **Writing:** Compare and Contrast – Cause and Effect – Purpose and Function – Job Application Letter – Drafting Resume / CV, – Inferring the graphical / Pictorial representations – Bar chart – Pie chart, Instruction – common and technical instructions for a process or a component.

**UNIT - V TECHNICAL REPORT WRITING 9**

**Listening:** Key note speeches – Annual Reports of institutions / companies. **Speaking:** Answering to the Mock Panel Interview – Sharing of interview experiences – presenting a Technical Paper. **Reading:** Annual Reports – Company Reports – Newspaper reports – Comprehension passages. **Writing:** Homophones – Abbreviations and Acronyms – SI Units – Report Writing with recommendations – Inferring the Graph – Flow Chart – Tables – Technical Papers.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Board of editors. **“Fluency in English a Course book for Engineering and Technology”**. Orient Blackswan, Hyderabad: 2016
2. Raman, Meenakshi and Sharma, Sangeetha- **“Technical Communication Principles and Practice”**. Oxford University Press: New Delhi, 2014.

**REFERENCES:**

1. Booth-L. Diana, **“Project Work”**, Oxford University Press, Oxford: 2014
2. Grussendorf, Marion, **“English for Presentations”**, Oxford University Press, Oxford: 2007
3. Means, L. Thomas and Elaine Langlois, **“English & Communication For Colleges”**. Cengage Learning, USA: 2007
4. Board of Editor, **“Advanced Technical Communication”**, Great Mind Publication, Chennai : 2019

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ADVANCED TECHNICAL COMMUNICATION											Course Code : 20HS201				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
C109.1	Listen, Understand and create technical correspondence at advanced level.										I-V		9,10,12	3	
C109.2	Respond or answer to the contextual questions, interview questions, form instructions, draft reports										I-V		9,10,12	3	
C109.3	Speak and analyze social issues, come out with effective ideas for discussion, understand the passages for meaning and vocabulary										I-V	AD	9,10,12	3	
C109.4	Assess error free technical writings, create legible and coherent technical papers, derive ideas of the given texts in a precise form										I-V	AD	9,10,12	3	
C109.5	Remember the updated elements of communication skills, nuances of non-verbal communication, business communication										I-V	AD	9,10,12	3	
C109.6	Create technical instructions, process instructions, self-appraisals, Resumes, reports on various situations										I-V	AD	9,10,12	3	
CO-PO mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C109.1	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1
C109.2	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1
C109.3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	1
C109.4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	1
C109.5	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1
C109.6	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1

<b>20BS201</b>	<b>LAPLACE TRANSFORM AND ADVANCED CALCULUS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**OBJECTIVES:**

- To make the student familiar with topics such as Multiple Integrals, Vector Calculus, Analytic Functions, Complex Integration and Laplace Transform.
- To learn the concept of basic Vector Calculus which can be widely used for Modeling the various laws of Physics.
- To understand the various methods of Complex Analysis and Laplace Transform can be used for efficiently solving the problems that occur in various branches of Engineering disciplines.

**PRE-REQUISITE: NIL**

**UNIT-I LAPLACE TRANSFORM 12**  
 Existence Conditions – Transforms of Elementary Functions – Transform of Unit Step Function and Unit Impulse Function – Basic Properties – Shifting Theorems -Transforms of Derivatives and Integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of Periodic Functions – Application to Solution of Linear Second Order Ordinary Differential Equations with Constant Coefficients.

**UNIT-II MULTIPLE INTEGRALS 12**  
 Double integrals – Change of order of integration – Double integrals in Polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of Variables in Double and Triple integrals.

**UNIT - III VECTOR CALCULUS 12**  
 Gradient and Directional Derivative – Divergence and Curl - Vector Identities – Irrotational and Solenoidal Vector fields – Line Integral over a Plane curve – Surface Integral - Area of a Curved Surface - Volume Integral – Green’s, Gauss divergence and Stoke’s theorems – Verification and Application in evaluating Line, Surface and Volume Integrals.

**UNIT - IV ANALYTIC FUNCTIONS 12**  
 Analytic functions – Necessary and Sufficient Conditions for Analyticity in Cartesian and Polar Coordinates – Properties – Harmonic Conjugates – Construction of Analytic Function – Conformal Mapping – Mapping by Functions  $w = z+c$ ,  $cz$ ,  $1/z$ ,  $z^2$  -Bilinear transformation.

**UNIT - V COMPLEX INTEGRATION 12**  
 Line integral – Cauchy’s Integral Theorem – Cauchy’s Integral Formula – Taylor’s and Laurent’s Series – Singularities – Residues – Residue Theorem – Application of Residue Theorem for Evaluation of Real Integrals – Use of Circular Contour.

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2017.
2. T. Veerarajan., “Engineering Mathematics I”, The Tata Mc Graw Hill Publication-New Delhi, First Edition 2018.

**REFERENCES:**

1. Kreyszig Erwin, “Advanced Engineering Mathematics”, John Wiley and Sons, 9<sup>th</sup> Edition, New Delhi, 2006.
2. James Stewart, “Calculus, Early Transcendental”, Cengage Learning, 7th Edition, New Delhi, 2015.
3. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics II”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 9<sup>th</sup> Edition, 2014.
4. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics II”, Narosa Publications, New Delhi, 5<sup>th</sup> Edition, 2016.
5. Sastry, S.S. “Engineering Mathematics”, Vol.I & II, PHI Learning Pvt. Ltd, 4<sup>th</sup> Edition, New Delhi, 2014.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : LAPLACE TRANSFORM AND ADVANCED CALCULUS										Course Code : 20BS201					
CO	Course Outcomes									Unit	K	POs	PSOs		
C110.1	Determine the Laplace transform of standard functions using properties									I	K3	1,2,3,8,9	1		
C110.2	Apply Laplace transform and inverse transform to solve the initial value problems									I	K3	1,2,3,8,9	1		
C110.3	Solve the multiple integrals and apply the concept to find areas, volumes									II	K3	1,2,3,8,9	1		
C110.4	Determine the line, surface and volume integrals using Green’s, Gauss and Stokes theorems									III	K3	1,2,3,8,9	1		
C110.5	Determine Analytic functions, Bilinear Transformations and apply the concept of conformal mapping to find the images of given curves.									IV	K3	1,2,3,8,9	1		
C110.6	Determine the Contour Integrals using Cauchy’s Integral and Residue theorems.									V	K3	1,2,3,8,9	1		
CO-PO mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
C110.1	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.2	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.3	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.4	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.5	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.6	3	2	1	-	-	-	-	1	1	-	-	-	2	-	

<b>20BS202</b>	<b>APPLIED PHYSICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To introduce the phase diagrams and their usage.
- To establish testing methodologies of materials science.
- To inculcate the knowledge on New Engineering Materials for Mechanical and Automobile Engineering Applications.

**PRE-REQUISITE: NIL****UNIT-I PHASE DIAGRAMS 9**

Solid solutions - Hume Rothery's rules – the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

**UNIT-II FERROUS ALLOYS 9**

The iron-carbon equilibrium diagram – phases, invariant reactions – microstructure of slowly cooled steels – eutectoid steel, hypo and hypereutectoid steels – effect of alloying elements on the Fe-C system – diffusion in solids – Fick's law – phase transformations – T-T-T diagram for eutectoid steel – pearlitic and martensitic transformations – tempering of martensite steels – stainless steels – cast irons

**UNIT - III NON DESTRUCTIVE TESTING METHODS 9**

Non-destructive testing – objectives of NDT – types of defects – cracking, spalling, staining, honeycombing, dusting and blistering – methods of NDT – Liquid penetration method – radiographic testing –magnetic particle inspection-thermography testing– Eddy current testing.

**UNIT - IV MAGNETIC AND DIELECTRIC MATERIALS 9**

Magnetic materials: Origin of magnetic moment – Bohr magneton- comparison of Dia, para and ferro magnetism- domain theory – types of energy- hysteresis- soft and hard magnetic materials-antiferromagnetic materials-ferrites and its applications. Dielectric materials: Electrical susceptibility – dielectric constant- electronic, ionic, orientational and space charge polarization- Langevin-Debye equation - internal field - clausius- mosotti relation (derivation)- dielectric loss – dielectric breakdown- ferroelectricity and application.

**UNIT - V ADVANCED ENGINEERING MATERIALS 9**

Composites: Classifications, role of matrix and reinforcement processing of fiber – reinforced plastics – Polymers: types of polymers- properties and engineering applications-metallic glasses: production and types –melt spinning process – applications – shape memory alloys: phases, shape memory effect, pseudo elastic effect, NiTi alloy, applications – Nanomaterials: preparation (bottom up and top down approaches), properties and applications – Biomaterials and its applications.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. V.Raghavan, “Materials science and Engineering (a first course)”, PHI learning private limited, Delhi, 6<sup>th</sup> Edition, 2017
2. S. O. Pillai, “Solid State Physics”, New Age International publisher, 8<sup>th</sup> Edition, 2018
3. Charles Kittel, “Introduction to Solid State Physics”, John Wiley & sons, 8<sup>th</sup> Edition, 2015

**REFERENCES:**

1. B. K. Pandey and S.Chaturvedi, “Engineering Physics”, Cengage learning India Pvt Ltd, 2013
2. D. K. Bhattacharya and Poonam tendon, “Engineering Physics”, Oxford University Press, New Delhi, First Edition, 2017
3. Dr. V. Jeyakumar, “Engineering Metallurgy”, Lakshmi Publications, 2017

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : APPLIED PHYSICS											Course Code: 20BS202				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
C111.1	Explain various phase diagrams										1	K2	1,2	1	
C111.2	Demonstrate the microstructure and phase transformations of ferrous alloys										2	K3	1,2,3,8,9,10	1	
C111.3	Infer the defects by Non destructive testing										3	K2	1,2,8,9,10	1	
C111.4	Distinguish magnetic properties of materials										4	K2	1,2	1	
C111.5	Explain dielectric properties of materials and their applications										4	K2	1,2,8,9,10	1	
C111.6	Discuss the informations on composites, metallic glasses, SMA and nanomaterials										5	K2	1,2,8,9,10	1	
CO-PO Mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
C111.1	2	1									2	1	1		
C111.2	3	2	1					1	1	1	3	2	1		
C111.3	2	1						1	1	1	2	1	1		
C111.4	2	1									2	1		1	
C111.5	2	1						1	1	1	2	1		1	
C111.6	2	1						1	1	1	2	1		1	

20GE201

**ENGINEERING GRAPHICS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To develop graphic skills for communication of concepts, ideas and design of engineering products.
- To expose national standards related to technical drawings.

**PRE-REQUISITE: NIL****CONCEPTS AND CONVENTIONS (Not for Examination)**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT-I PROJECTION OF POINTS AND LINES 6+6**  
Orthographic projection – Principles - Principal planes - Projection of points in all quadrants - Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method

**UNIT-II PROJECTION OF PLANE SURFACES 6+6**  
Projection of planes (Polygonal and Circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT - III PROJECTION OF SOLIDS 6+6**  
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

**UNIT - IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+6**  
Sectioning of simple solids in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining true shape of section - Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone.

**UNIT - V ISOMETRIC PROJECTION AND FREEHAND SKETCHING 6+6**  
Principles of Isometric Projection – Isometric scale – Isometric projections of simple solids - truncated Prisms and Pyramids.  
Visualization concepts and Free Hand sketching : Principles – Representation of Three Dimensional objects – Layout of views - Freehand sketching of multiple views from pictorial views of objects

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 30<sup>th</sup> Edition, 2017.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 15<sup>th</sup> Edition, 2018.

**REFERENCES:**

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53<sup>rd</sup> Edition, 2019.
2. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education, 3<sup>rd</sup> Edition, 2012.

**PUBLICATION OF BUREAU OF INDIAN STANDARDS:**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001: Technical drawings - General principles of presentation.
4. IS 11669 – 1986: General principles of dimensioning on technical drawings.
5. SP 46 (2003): Engineering Drawing Practice for Colleges.
6. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

**SPECIAL POINTS APPLICABLE TO EXAMINATIONS ON ENGINEERING GRAPHICS:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ENGINEERING GRAPHICS						Course Code : 20GE201								
CO	Course Outcome					Unit	K –CO	POs	PSO					
C114.1	Familiarize with the fundamentals and standards of engineering graphics.					-	K2	1,2,8	2					
C114.2	Draw the orthographic projections of points and lines.					I	K3	1,2,3,8	2					
C114.3	Draw the orthographic projections of plane surfaces.					II	K3	1,2,3,8	2					
C114.4	Draw the projections of simple solids like prisms, pyramids, cylinder and cone.					III	K3	1,2,3,8	2					
C114.5	Draw the projections of sectional views of solids and develop its lateral surfaces.					IV	K3	1,2,3,8	2					
C114.6	Draw the isometric projection and free hand sketching of simple objects.					V	K3	1,2,3,8	2					
CO-PO Mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C114.1	2	1	-	-	-	-	-	1	-	-	-	-	-	1
C114.2	3	2	1	-	-	-	-	1	-	-	-	-	-	1
C114.3	3	2	1	-	-	-	-	1	-	-	-	-	-	1
C114.4	3	2	1	-	-	-	-	1	-	-	-	-	-	1
C114.5	3	2	1	-	-	-	-	1	-	-	-	-	-	1
C114.6	3	2	1	-	-	-	-	1	-	-	-	-	-	1

<b>20GE202</b>	<b>ENGINEERING MECHANICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**OBJECTIVES:**

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of Engineering.
- To apply the techniques to find out centroid and mass moment of inertia of plane surfaces.
- To enhance skills to carry out kinematic and kinetic analyses for system of particles.

**PRE-REQUISITE: NIL**

<b>UNIT-I</b>	<b>BASICS AND STATICS OF PARTICLES</b>	<b>12</b>
Introduction - Units and Dimensions - Laws of Mechanics - Vectorial representation of forces – Resolution and Composition of forces -Equilibrium of a particle –Forces in space –Equilibrium of a particle in space – Equivalent systems of forces –Principle of transmissibility –Single equivalent force.		
<b>UNIT-II</b>	<b>EQUILIBRIUM OF RIGID BODIES</b>	<b>12</b>
Free body diagram –Types of supports and their reactions –Moments and Couples –Moment of a force about a point and about an axis, Vectorial representation of moments and couples –Scalar components of a moment-Varignon’s theorem –Equilibrium of Rigid bodies in two dimensions.		
<b>UNIT - III</b>	<b>PROPERTIES OF SURFACES AND SOLIDS</b>	<b>12</b>
First moment of area and the Centroid of sections- Rectangle, circle, triangle from integration- T section , I section, Angle section, Hollow section by using standard formula- Pappus and Guldinus theorems - moment of inertia of plane areas -Parallel and perpendicular axis theorem -radius of gyration.		
<b>UNIT - IV</b>	<b>DYNAMICS OF PARTICLES</b>	<b>12</b>
Displacements -Velocity and acceleration, their relationship –Rectilinear and Curvilinear motion –Newton’s law –Work Energy Equation of particles –Impulse and Momentum.		
<b>UNIT - V</b>	<b>FRICITION AND ELEMENTS OF RIGID BODY DYNAMICS</b>	<b>12</b>
Frictional force -Laws of friction -Simple contact friction –Rolling resistance –Belt friction –Translation and Rotation of Rigid Bodies –Velocity and acceleration –General Plane motion.		

**TOTAL: 60 PERIODS****TEXT BOOKS:**

1. Vela Murali, “Engineering Mechanics”, Oxford University Press, 2010.
2. Beer FP, Mazurek DF, Sanghi S, Eisenberg ER, Johnson ER and Cornwell PJ, “Vector Mechanics for Engineers: Statics and Dynamics”, Tata McGraw Hill Education Private Limited, 10<sup>th</sup> Edition, 2012.

**REFERENCES:**

1. Hibbeler RC, “Engineering Mechanics: Statics & Dynamics”, Pearson India Education Services Private Limited, 13<sup>th</sup> Edition, 2012.
2. Palanichamy M.S and Nagan S, “Engineering Mechanics –Statics and Dynamics”, Tata McGraw Hill, 3<sup>rd</sup> Edition, 2004
3. Meriam J.L and Kraig L.G, ‘Engineering Mechanics-Statics and Dynamics’, John Wiley & Sons, Newyork, 2008
4. Irving H Shames, “Engineering Mechanics –Statics and Dynamics”, Pearson Education Asia Private Limited, 4<sup>th</sup> Edition, 2003.
5. Murugaperumal P, “Engineering Mechanics – Sri Krishna Hitech Publishing Company Private Limited., 2013.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Engineering Mechanics										Course Code: 20GE202				
CO	Course Outcomes									Unit	K-CO	POs	PSOs	
C113.1	Illustrate the vectorial and scalar representation of forces and moments.									I	K3	1, 2, 8	1	
C113.2	Solve problems in engineering systems using the concept of static equilibrium.									I	K3	1, 2, 3,8	1	
C113.3	Draw the free body diagram and apply equilibrium principles for two dimensional bodies.									II	K3	1, 2, 8	1	
C113.4	Determine the centroid and moment of inertia of plane lamina.									III	K3	1, 2, 8,9	1	
C113.5	Apply fundamental principles to solve problems in dynamics of particles.									IV	K3	1,2,8,9,10	1	
C113.6	Summarize the basic principles of friction and general plane motion.									V	K3	1,2,8,9,10,12	1	
CO-PO Mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C113.1	3	3	-	-	-	-	-	1	-	-	-	-	2	-
C113.2	3	3	1	-	-	-	-	1	-	-	-	-	2	-
C113.3	3	3	-	-	-	-	-	1	-	-	-	-	2	-
C113.4	3	3	-	-	-	-	-	1	2	-	-	-	2	-
C113.5	3	3	-	-	-	-	-	1	2	1	-	-	2	-
C113.6	3	3	1	-	-	-	-	1	-	1	-	1	2	-

<b>20GE203</b>	<b>BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the concept of electric circuit laws and theorems.
- To analyze the single phase and three phase circuits.
- To study about the working principles of Electrical Machines, electronic devices, circuits and various measuring instruments.

**PRE-REQUISITE: NIL****UNIT-I DC NETWORKS 9**

Basic Concepts-Atomic structure-Electric charge-Electric Current-Circuit components -Resistance-Capacitance -Inductance-potential and potential difference-Ohm's Law-work-power and Energy-DC Network Terminologies-Series and parallel circuits-Voltage and current divider rules-Kirchhoff's Laws-Maxwell's mesh current method-Nodal Analysis.

**UNIT-II AC FUNDAMENTALS 9**

Introduction to AC circuits –Generation of AC power-advantages– waveforms and RMS value –average value-form factor and peak factor-power and power factor, single phase and three-phase balanced circuits.

**UNIT - III ELECTRICAL MACHINES 9**

Construction , principles of operation, characteristics and applications of ; DC machines-Transformers (single and three phase ) -Synchronous machines -three phase and single phase induction motors.(Qualitative Treatment Only)

**UNIT - IV ELECTRONIC DEVICES & CIRCUITS 9**

Types of Materials – conductor, semiconductor and insulators-comparison-Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics - Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier.

**UNIT - V MEASUREMENTS & INSTRUMENTATION 9**

Classification of instruments - Types of indicating Instruments –moving coil and moving iron instruments-dynamometer type wattmeter and induction type energy meter- three-phase power measurements - Introduction to transducers - Classification of Transducers-selection of transducers- Resistive, Inductive, Capacitive.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. S.K Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson, second Edition 2017.
2. D P Kothari and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint, 2017

**REFERENCES:**

1. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2017
2. N K De, Dipu Sarkar, "Basic Electrical Engineering", Universities Press (India)Private Limited 2016
3. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2015
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2014
5. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2013
6. Allan S Moris, "Measurement and Instrumentation Principles", Elsevier, First Indian Edition, 2011
7. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Basic Electrical, Electronics and Instrumentation Engineering		Course Code : 20GE203			
CO	Course Outcome	Unit	K – CO	POs	PSO
C114.1	Explain the basic circuit components and apply the Network theorems to solve simple and complex linear circuits.	1	K3	1,2,3,4,9	1
C114.2	Solve the series, parallel A.C circuits and explain the three phase balanced star, delta connected network.	2	K3	1,2,3,4,9	1
C114.3	Demonstrate and analyze the construction, operation and characteristics of D.C, A.C machines, single and three phase transformers.	3	K3	1,2,3,4,9	1
C114.4	Compare the configurations, Characteristics and biasing of Diode, BJT, OP-AMP and its applications.	4	K3	1,2,3,4,9	1
C114.5	Classification of various types of transducers and explain the construction and working principle of display devices.	5	K3	1,2,3,4,9	1
C114.6	Explain the construction and working principle of measuring instruments.	-	K3	1,2,3,4,9	1

CO-PO Mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C114.1	2	3	2	2	-	-	-	-	2	-	-	-	2	-	-
C114.2	3	2	3	3	-	-	-	-	2	-	-	-	3	-	-
C114.3	2	2	2	2	-	-	-	-	2	-	-	-	2	-	-
C114.4	3	1	1	1	-	-	-	-	2	-	-	-	2	-	-
C114.5	2	1	2	3	-	-	-	-	3	-	-	-	2	-	-
C114.6	2	1	2	3	-	-	-	-	3	-	-	-	2	-	-

<b>20HS2L1</b>	<b>COMMUNICATION SKILLS LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**OBJECTIVES:**

- This course is framed for imparting practical approach in learning and enhancing communication skill to develop in students.
- Students will be able to identify appropriate expressions in speaking and writing.
- They will also be able to understand the style and perfection of language in reading and listening various contexts of engineering and technology.
- The course will benefit to the students to gain confidence for every day communication, aptitude test and interviews.

**PRE-REQUISITE: NIL**

**UNIT-I LISTENING 6**  
 Listen and takes notes of Lecture, Listen and Write appropriate word, Talks on Engineering and Technology, Developing effective listening skills, barriers to effective listening

**UNIT-II SPEAKING 6**  
 Self-Introduction, Role play of Celebrities, Sharing memorable incidents.

**UNIT - III READING 6**  
 Reading Online Blogs, Reading Advertisement in Online, Newspaper archives reading

**UNIT - IV WRITING 6**  
 Process Description, Narrating experiences, Creating Email blogs, Review Writing – Books, Movies, and Journals

**UNIT - V SUMMARIZED ACTIVITIES 6**  
**Reading** – cloze exercises, Identifying redundant words, Jargon words, Foreign words, Technical terms.  
**Writing** – Error free sentences, Sequential paragraphs, Essay writing on various levels – basic, middle, and advanced. **Speaking** – Face to face conversation on specific topics, interviewing celebrities, getting acquaintance with new people, sharing information with persons from abroad.

**TOTAL: 30 PERIODS**

**TEXT BOOKS:**

1. E. Suresh Kumar et al. "Communication for Professional Success". Orient Blackswan: Hyderabad, 2015

**REFERENCES:**

1. Butterfield, "Jeff Soft Skills of Everyone". Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students, Orient BlackSwan: Hyderabad, 2016.
3. Raman, Meenakshi and Sangeetha Sharma. "Professional Communication". Oxford University Press: Oxford, 2014.
4. S. Hariharanetal. "Soft Skills". MJP Publishers: Chennai, 2010

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : COMMUNICATION SKILLS LABORATORY		Course Code : 20HS2L1													
CO	Course Outcome	EXP	K –CO	POs	PSO										
C115.1	Express ideas and concepts on par global communication	1,2	K3	9,10,12	-										
C115.2	Involve inter-personal communication with flair and error-free verbatim	3,4	K3	9,10,12	-										
C115.3	Face interviews confidently and respond in proper language ability	5,6	K3	9,10,12	-										
C115.4	Participate in group discussion and share innovative ideas in technical environments	7,8	K3	9,10,12	-										
C115.5	Adapt multi-national exposure on employment	9,10	K3	9,10,12	-										
C115.6	Master all-round competency in delivering apt communication for employability	1-10	K3	9,10,12	-										
CO-PO Mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C115.1	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
C115.2	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
C115.3	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
C115.4	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
C115.5	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
C115.6	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-

<b>20GE2L1</b>	<b>ELECTRICAL, ELECTRONICS AND INSTRUMENTATION LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVES:**

- To train the students in performing various tests on electrical drives, electronic devices, measuring instruments sensors and circuits.

**PRE-REQUISITE: NIL****LIST OF EXPERIMENTS:**

- Load test on separately excited DC shunt generator
- Load test on Single phase Transformer
- Load test on single phase Induction motor
- Load test on DC shunt motor.
- Measurement of three phase power
- Verification of Circuit Laws
- Transistor based application circuits
- Study of CRO.
- Characteristics of LVDT
- Calibration of Rotameter
- Measurement of temperature by using RTD
- Measurement of temperature by using Thermistor

**TOTAL: 60 PERIODS****LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	D. C. Motor Generator Set	2
2	D.C. Shunt Motor	2
3	Single Phase Transformer	2
4	Single Phase Induction Motor	2
5	Ammeter A.C and D.C	20
6	Voltmeters A.C and D.C	20
7.	Watt meters LPF and UPF	4
8.	Resistors & Breadboards	-
9.	Cathode Ray Oscilloscopes	4
10.	Dual Regulated power supplies	6
11.	A.C. Signal Generators	4
12.	Transistors (BJT, JFET)	-

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Electrical, Electronics and Instrumentation Laboratory		Course Code : 20GE2L1			
CO	Course Outcome	EXP	K-CO	POs	PSO
C116.1	Determine the efficiency of DC shunt motor, single phase induction motor, single phase transformer, Draw the internal and external characteristics of separately excited DC shunt generator and Describe the working of DC and AC motor starters.	1,2	K2	1,2,3,4,9	1
C116.2	Calculate the power and power factor of three phase circuit by two wattmeter method and verify the circuit laws and theorems.	3,4	K3	1,2,3,4,9	1
C116.3	Explain the working of diode and transistor based application circuits such as clipper and Common Emitter Amplifier.	5,6	K3	1,2,3,4,9	1
C116.4	Discuss the operation of Cathode Ray Oscilloscope and measure the AC quantities such as voltage, current and Explain the characteristics of Linear Variable differential transformer.	7,8	K3	1,2,3,4,9	1
C116.5	Measure the error during the flow of fluid or gas in Rotameter by calibrating them	9,10	K3	1,2,3,4,9	1
C116.6	Calculate and sense the temperature by Resistance Temperature Detector and Thermistor.	11,12	K3	1,2,3,4,9	1

**CO-PO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C116.1	2	3	2	2	-	-	-	-	2	-	-	-	2		
C116.2	3	2	3	3	-	-	-	-	2	-	-	-	3		
C116.3	2	2	2	2	-	-	-	-	2	-	-	-	2		
C116.4	3	1	1	1	-	-	-	-	2	-	-	-	2		
C116.5	2	1	2	3	-	-	-	-	3	-	-	-	2		
C116.6	2	1	2	3	-	-	-	-	3	-	-	-	2		

<b>20BS301</b>	<b>TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**OBJECTIVES:**

- To make the student familiar with the topics such as Fourier Transforms, Z- Transforms and Fourier series.
- To learn the formation of partial differential equations and the solution of first order and higher order partial differential equations.
- To apply Fourier series to solve one dimensional wave, one and two dimensional heat equations which occur frequently in various branches of Engineering disciplines.

**PRE-REQUISITE: NIL**

**UNIT-I PARTIAL DIFFERENTIAL EQUATIONS 12**

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange’s linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

**UNIT-II FOURIER SERIES 12**

Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval’s identity – Harmonic analysis

**UNIT - III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

**UNIT - IV FOURIER TRANSFORMS 12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties– Transforms of simple functions – Convolution theorem – Parseval’s identity.

**UNIT - V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 12**

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. Grewal .B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44<sup>th</sup> Edition, 2017.
2. Bali.N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications Pvt. Ltd, 9<sup>th</sup> Edition, 2014

**REFERENCES:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", John Wiley,India, 8th Edition, 2016.
2. James.G., "Advanced Modern Engineering Mathematics", Pearson Education, 3<sup>rd</sup> Edition, 2007.
3. Andrews.L.C., L.C and Shivamoggi .B, "Integral Transforms for Engineers",SPIE Press, 1999.
4. Narayanan.S., Manicavachagom Pillay.T.K. and Ramanaiah.G, "Advanced Mathematics for Engineering Students", S.Viswanathan Publishers Pvt. Ltd,Chennai, Vol. II 2003 & Vol.III 2002.
5. Ramana.B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Transforms and Partial Differential Equations											Course Code : 20BS301				
CO	Course Outcomes										Unit	K	POs	PSOs	
C201.1	Solve the given first order partial differential equations.										1	K3	1, 2, 3, 8&9	1	
C201.2	Solve linear partial differential equation of second and higher order with constant coefficients.										1	K3	1, 2, 3, 8&9	1	
C201.3	Solve differential equations using Fourier series analysis.										2	K3	1, 2, 3, 8&9	1	
C201.4	Solve one, two dimensional heat flow problems and one dimensional wave equation problems.										3	K3	1, 2, 3, 8&9	1	
C201.5	Compute the Fourier transforms of various functions.										4	K3	1, 2, 3, 8&9	1	
C201.6	Apply Z-transforms techniques to solve difference equation.										5	K3	1, 2, 3, 8&9	1	
CO-PO mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C201.1	3	2	1					1	1				2		
C201.2	3	2	1					1	1				2		
C201.3	3	2	1					1	1				2		
C201.4	3	2	1					1	1				2		
C201.5	3	2	1					1	1				2		
C201.6	3	2	1					1	1				2		

<b>20ME301</b>	<b>STRENGTH OF MATERIALS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To study the concepts of simple stresses, strains, and strain energy due to external loads.
- To understand the two dimensional stress systems, stresses and deformations induced in thin and thick shells.
- To compute stresses and deformation in circular shafts and helical spring due to torsion.
- To understand the concept of shearing force and bending moment due to external loads in beams and their effect on stresses.
- To determine the deflection of beams by various methods and crippling load of columns under various conditions.

**PRE-REQUISITE:**

Course Code: 20BS101 & 20GE202

Course name: Fundamentals of Engineering Mathematics & Engineering Mechanics

<b>UNIT-I</b>	<b>STRESS, STRAIN AND DEFORMATION OF SOLIDS</b>	<b>9</b>
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Rigid bodies and deformable solids – Tension, Compression and Shear Stresses. Stress-Strain Diagram for ductile and brittle materials, True stress, True strain. Deformation of simple and compound bars, Thermal stresses, Elastic constants, Volumetric strain, Strain energy and unit strain energy, Strain energy in Uniaxial loads.

<b>UNIT-II</b>	<b>ANALYSIS OF STRESSES IN TWO DIMENSIONS</b>	<b>9</b>
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Stresses in thin cylindrical shell, circumferential and longitudinal stresses. Deformation in thin and thick cylinders, Compound cylinders, Stresses in spherical shells, Deformation in spherical shells. Stresses on inclined planes, principal stresses and principal planes, Mohr's circle for plane stress.

<b>UNIT - III</b>	<b>TORSION</b>	<b>9</b>
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Torsion formulation, stresses and deformation in circular and hollow shafts, Stepped shafts. Deflection in shafts fixed at the both ends. Stresses in helical springs, Deflection of helical springs

<b>UNIT - IV</b>	<b>BEAMS</b>	<b>9</b>
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Beams – types, Standard Rolled sections, transverse loading on beams, Shear force and bending moment in beams - Cantilever, Simply supported and over hanging. Theory of simple bending, bending stress distribution, Load carrying capacity, Proportioning of sections, Flitched beams, Shear stress distribution.

<b>UNIT - V</b>	<b>DEFLECTION OF BEAMS, COLUMNS</b>	<b>9</b>
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Computation of slopes and deflections in beams - Double Integration method, Macaulay's method. Maxwell's reciprocal theorems.

COLUMNS–Long and short columns, Euler's formula for crippling load with different end conditions, eccentric loading, Rankine formulae.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Beer F. P. and Johnson R, “Mechanics of Materials”, McGraw-Hill Book Co, 8<sup>th</sup> Edition, 2019.
2. Bansal R.K, “A Textbook of Strength of Materials”, Laxmi Publications Pvt. Ltd., New Delhi, 2013. Khurmi R.S, Khurmi N, “Strength of Materials”, S.Chand, New Delhi, 2013.

**REFERENCES:**

1. Popov E.P, “Engineering Mechanics of Solids”, Prentice-Hall of India, New Delhi, 2<sup>nd</sup> Edition, 2015.
2. S. S. Bhavikatti, Strength of Materials, Vikas Publishing House- Pvt. Ltd., 4<sup>th</sup> Edition. 2013.
3. Rajput, R K, “Strength of Materials”, S.Chand & Co, New Delhi, 2015
4. Singh D.K, “Mechanics of Solids” Pearson Education, 2008.
5. R. C. Hibbeler, Mechanics of Materials, Prentice Hall, Pearson Education., 2005

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: STRENGTH OF MATERIALS										Course Code: 20ME202					
CO	Course Outcomes									Unit	K –CO	POs	PSO		
C202.1	Explain the fundamental concepts of stress and strain									I	K2	1,2, 8,10	1,2		
C202.2	Determine the deformation of bars while applying loads									I	K3	1,2,3, 9	1,2		
C202.3	Compute stresses due to internal pressure in cylinders and spherical shells									II	K3	1,2,3, 10	1,2		
C202.4	Apply basic equation of simple torsion in designing of shafts and helical springs									III	K3	1,2,3, 10	1,2		
C202.5	Construct Shear force and Bending moment diagrams for beams for various combinations of transverse loads.									IV	K3	1,2,3, 10	1,2		
C202.6	Calculate the slope and deflection of beams under various loading conditions.									V	K3	1,2,3,10,12	1,2		
CO-PO Mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C202.1	2	1	-	-	-	-	-	2	-	2	-	-	2	1	-
C202.2	3	2	1	-	-	-	-	-	2	-	-	-	2	1	-
C202.3	3	2	1	-	-	-	-	-	-	2	-	-	2	1	-
C202.4	3	2	1	-	-	-	-	-	-	2	-	-	2	1	-
C202.5	3	2	1	-	-	-	-	-	-	2	-	-	2	1	-
C202.6	3	2	1	-	-	-	-	-	-	2	-	2	2	1	-

<b>20ME302</b>	<b>FLUID MECHANICS AND MACHINERY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the properties of fluids and flow characteristics.
- To gain knowledge about the applications of the conservation laws to flow through pipes.
- To study about dimensional analysis and model analysis
- To understand the working principle and performance of hydraulic turbines.
- To understand the working principle and performance of hydraulic pumps

**PRE-REQUISITE:**

Course Code: 20BS101

Course Name: Fundamentals of Engineering Mathematics

**UNIT-I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow measurement, Flow characteristics, Types of fluid flow, concept of control volume, application of continuity equation, energy equation and momentum equation.

**UNIT-II FLOW THROUGH CIRCULAR CONDUITS 9**

Laminar flow through circular conduits and circular annuli, Hagen Poiseuille's Equation, Darcy Weisbach equation, major and minor losses, Hydraulic and energy gradient, Moody diagram. Commercial pipes -Flow through pipes in series and parallel. Boundary layer concepts, types of boundary layer thickness.

**UNIT - III DIMENSIONAL ANALYSIS 9**

Need for dimensional analysis, methods of dimensional analysis. Similitude –types of similitude. Dimensionless parameters, application of dimensionless parameters. Model analysis.

**UNIT - IV TURBINES 9**

Classification of turbines, heads and efficiencies, velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles, work done by water on the runner, draft tube. Specific speed, unit quantities, performance curves for turbines, governing of turbines. Concepts of Water Hammer.

**UNIT - V PUMPS 9**

Impact of jets, Euler's equation. Theory of roto dynamic machines, various efficiencies, velocity components at entry and exit of the rotor, velocity triangles. Centrifugal pumps– working principle, work done by the impeller, performance curves. Reciprocating pump- working principle. Rotary pumps –classification, working principle. Submergible pumps.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", 10<sup>th</sup> Edition, Laxmi Publications Pvt. Ltd., 2018.
2. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2013.
3. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House Pvt. Ltd., New Delhi, 2016

**REFERENCES:**

1. Frank White, "Fluid Mechanics", 8th Edition, McGraw Hill Education (India) Pvt. Ltd, 2017.
2. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010.
3. Yunus A Cengel and John A Cimbala, Fluid Mechanics- Fundamentals & Applications, 3<sup>rd</sup> Edition, Tata McGraw Hill, 2013.
4. Fox and MacDonald, Introduction to Fluid Mechanics, 8<sup>th</sup> Edition, Wiley India, 2014.  
S. K. Som, Gautam Biswas, Suman Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, 3<sup>rd</sup> Edition, Tata McGraw-Hill Education, 2012.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: FLUID MECHANICS AND MACHINERY										Course Code: 20ME302					
CO	Course Outcomes									Unit	K –CO	POs	PSO		
C203.1	Determine the effect of fluid properties on a flow system.									I	K2	1,2,3,9	1,2,3		
C203.2	Apply the kinematic concepts and dynamic concepts which relates to the conservation principles of mass and energy									I	K3	1,2,3,9	1,2,3		
C203.3	Compute losses in circular conduits using conservation laws									II	K3	1,2,3,8,9	1,2,3		
C203.4	Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity									III	K3	1,2,3,9	1,2,3		
C203.5	Analyze the performance of hydraulic turbines.									IV	K4	1,2,3,4, 8,9,10	1,2,3		
C203.6	Analyze the performance of pumps.									V	K4	1,2,3,4,8,9,12	1,2,3		
CO-PO Mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C203.1	3	2	1	0	0	0	0	0	1	0	0	0	3	2	1
C203.2	3	2	1	0	0	0	0	0	1	0	0	0	3	2	1
C203.3	3	2	1	0	0	0	0	2	2	0	0	0	3	2	1
C202.4	3	2	1	0	0	0	0	0	2	0	0	0	3	2	1
C202.5	3	3	2	1	0	0	0	2	2	1	0	0	3	2	1
C202.6	3	3	2	1	0	0	0	2	2	0	0	1	3	2	1

<b>20AE301</b>	<b>APPLIED THERMODYNAMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To impart knowledge of basic principles of thermodynamics via real world engineering examples
- To analyse and evaluate cardinal air standard cycles
- To analyse and evaluate cardinal Steam power cycles
- To analyse psychrometric concepts.
- To summarize the governing concepts of Refrigeration and Air conditioning
- To introduce various modes of heat transfer, related to real time scenarios of thermodynamics applied in engineering practice

**PRE-REQUISITE:**

Course Code : 20BS101

Course Name: Fundamentals of Engineering Mathematics

**UNIT-I LAWS OF THERMODYNAMICS 9**

System, thermodynamic equilibrium, zeroth law state, property, process, cycle, P-V & T-S diagrams, energy: work, heat, first law of thermodynamics, Concept of continuum, Perpetual motion machine, steady flow energy equation. Application of first law of thermodynamics to closed and open systems. Statements of second law of thermodynamics, heat engine, heat pump, refrigerator, Carnot cycle, Reversed Carnot cycle, Carnot theorem, entropy, Clausius inequality, Entropy generation principle.

**UNIT-II AIR STANDARD CYCLES AND COMPRESSORS 9**

Assumption for air standard cycles - Otto, Diesel, and Dual cycles, Comparison of cycles. Compressors, Classifications- Single stage and multi stage with intercooler, Volumetric efficiency.

**UNIT - III PROPERTIES OF STEAM AND VAPOUR POWER CYCLE 9**

Steam formation, properties of steam. Use of steam tables and Mollier chart, Ideal Rankine cycle, Reheat and regenerative cycle Rankine cycle.

**UNIT - IV PSYCHROMETRY, REFRIGERATION AND AIR CONDITIONING 9**

Properties of air, Psychrometric Processes and use of Psychrometric chart. Principles of refrigeration, Types - Vapour compression and Vapour absorption types – Coefficient Of Performance (COP), Properties of refrigerants, Summer, winter and Year round Air conditioning. Introduction to Automotive air conditioning systems.

**UNIT - V FUNDAMENTALS OF HEAT TRANSFER 9**

Modes of heat transfer, Fourier's law of conduction, one dimensional steady state conduction through plane and composite walls, cylinders and spheres. Free and forced convection, dimensionless numbers, thermal boundary layer, heat transfer co-efficient, simple problems in fins, heat transfer between fluids separated by plane and cylindrical walls, overall heat transfer coefficient, heat exchangers, LMTD, concept of radiation- Planck's law, Wien's displacement law, Stefan Boltzman law, Black body and Grey body radiation.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Nag P.K, "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, Fifth Edition, 2015.
2. Rajput R.K,"A Text Book of Engineering Thermodynamics", Laxmi Publications (P) Ltd, Fifth Edition, 2017.
3. Kothandaraman.C.P, "Fundamentals of Heat and Mass Transfer ", New Age International, 3<sup>rd</sup> Edition, 2006

**REFERENCES:**

1. Yunus A. Cengel and Michael A. Boles, "Thermodynamics", Tata McGraw-Hill, New Delhi, 8<sup>th</sup> Edition, 2015.
2. Holman J.P, "Heat and Mass Transfer", Tata McGraw Hill, New Delhi, 9<sup>th</sup> Edition, 2008.
3. Chattopadhyay P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Sachdeva R.C, "Fundamentals of Engineering Heat and Mass Transfer", 4<sup>th</sup> Edition, New Age International, 2010

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>APPLIED THERMODYNAMICS</b>											Course Code : 20AE301				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Apply the first law of thermodynamics for simple open and closed systems under steady state conditions and second law of thermodynamics to open and closed systems, calculate entropy and establish relations between ideal and real gases.										1	K2	1,2,7	-	
CO 2	Apply the thermodynamic concepts to different air standard cycles and solve problems using thermodynamic concepts related to air compressor										2	K2	1,2,7	-	
CO 3	Apply the properties of pure substance in vapour power cycles										3	K2	1,2,7	-	
CO 4	Apply psychrometric concepts and solve problems using thermodynamic concept.										4	K3	1,2,3,7	-	
CO 5	Compare and contrast between various types of refrigeration cycles										5	K2	1,2,3,7	-	
CO 6	Identify the mechanisms of heat transfer under steady state conditions and interpret and analyze the convective and radiation heat transfer.										5	K2	1,2,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 4	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-

<b>20AE302</b>	<b>AUTOMOTIVE ENGINES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To impart knowledge on basics of automotive SI and CI engines consisting of types, construction, working
- To understand the working of various fuel systems.
- To learn the SI engine and CI engine combustion processes.
- To understand the supercharging and turbo charging processes.
- To solve basic design problems of various operating parameters of the engine
- To analyze the performance and pollution characteristics of SI and CI engine and learn modern developments in IC engine

**PRE-REQUISITE: NIL****UNIT-I ENGINE CONSTRUCTION AND OPERATION 9**

Constructional details of spark ignition (SI) and compression ignition (CI) engines. Working principles. Two stroke SI and CI engines – construction and working. Comparison of SI and CI engines and four stroke and two stroke engines. Engine classification, firing order.

**UNIT-II FUEL SYSTEMS 9**

Air fuel ratio requirements of SI engines, Air fuel ratio and emissions, Working of a simple fixed venturi carburetor, Constant vacuum carburetor. MPFI. Gasoline direct injection systems. Diesel fuel injection systems-Jerk pumps, distributor pumps, pintle and multihole nozzles, Unit injector and CRDI systems. Need for a governor for diesel engines. Description of a simple diesel engine governor.

**UNIT - III COMBUSTION AND COMBUSTION CHAMBERS 9**

Combustion in SI and CI engines and stages of combustion. Dependence of ignition timing on load and speed. Knock in SI and CI engines. Combustion chambers for SI and CI engines. Direct and indirect injection combustion chambers for CI engines. Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design.

**UNIT - IV COOLING AND LUBRICATION SYSTEMS 9**

Need for cooling, types of cooling systems- air and liquid cooling systems. Thermo syphon and forced circulation and pressurized cooling systems. Properties of coolants. Requirements of lubrication systems. Types-mist, pressure feed, dry and wet sump systems. Properties of lubricants.

**UNIT - V SUPERCHARGING, TURBOCHARGING AND ENGINE TESTING 9**

Supercharging and Turbocharging, Different methods of turbocharging, Intercooling, Turbocharger controls including, waster gate, variable geometry, variable nozzle types. Dynamometers, Indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, Cylinder pressure measurement. Engine performance maps, Engine testing standards.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. V. Ganesan Internal Combustion Engines, 2017, 4<sup>th</sup> edition Tata Mc Graw Hill
2. Mathur and Sharma Internal Combustion Engines Dhanpat Rai and Sons, 2010
3. Heisler , Advanced Engine Technology SAE Publication 2005

**REFERENCES:**

1. Ramalingam K.K., "Internal Combustion Engines", 3<sup>rd</sup> edition, Sci-Tech Publications, 2018.
2. Edward F Obert Internal Combustion Engines, 2<sup>nd</sup> edition, ITC, 1951
3. H.N. Gupta Fundamentals of Internal Combustion Engines by, 2<sup>nd</sup> edition, PHI, 2003

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : AUTOMOTIVE ENGINES											Course Code : 20AE302				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Recognize the construction and working principle of SI and CI engines.										1	K2	1,2,7	-	
CO 2	Know about the fuel system and fuel pumps used in automotive engines.										2	K2	1,2,7	-	
CO 3	Identify the combustion processes and combustion chamber design.										3	K2	1,2,7	-	
CO 4	Know the engine cooling and lubrication systems.										4	K3	1,2,3,7	-	
CO 5	Express the working of supercharging and turbo charging										5	K2	1,2,3,7	-	
CO 6	Apply their knowledge in analyzing the engine performance and characteristics										5	K2	1,2,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 4	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-

<b>20HS301</b>	<b>UNIVERSAL HUMAN VALUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To create an awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

**PRE-REQUISITE: NIL****UNIT-I INTRODUCTION TO VALUE EDUCATION 9**

Value Education – Definition - Concept and Need for Value Education - The Evolution of Value Education: Natural acceptance, Self exploration - Fundamentals of value education - Happiness and Prosperity as parts of Value Education- fulfilling human aspirations.

**Practice sessions:** To discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

**UNIT-II HARMONY IN THE HUMAN BEING 9**

Human being vs Value education - 'I' and Body synchronization - Understanding Myself as Co-existence of the Self and the Body - Realization - Self, Body needs - Scanning of Karma -Self and Body- Understanding Sanyam and Health.

**Practice sessions:** To discuss the role others have played in making material goods available to self. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

**UNIT - III HARMONY IN THE FAMILY, SOCIETY AND NATURE 9**

Family as a basic unit of Human Interaction-Values in Relationships - The Basics for Trust and Respect in today's Crisis: Affection, e-Guidance, Reverence, Glory, Gratitude and Love –Harmony in society : Resolution, Prosperity, Fearlessness and Co-existence as Comprehensive Human Goal- Harmony in Nature: The Four Orders in Nature - The Holistic Perception of Harmony in Existence.

**Practice sessions:** To discuss on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education. Gratitude as a universal value in relationship. Discuss with scenarios. Elicit examples from students' lives

**UNIT - IV SOCIAL ETHICS 9**

The Basics for Ethical Human Conduct - Defects in Ethical Human Conduct - Holistic Alternative and Universal Order - Universal Human Order and Ethical Conduct - Human Rights violation and Social Disparities.

**Practice sessions:** To discuss human being as cause of imbalance in nature, pollution, depletion of resources and role of technology

**UNIT - V PROFESSIONAL ETHICS 9**

Value based Life and Profession - Professional Ethics and Right Understanding - Competence in Professional Ethics - Issues in Professional Ethics – The Current Scenario - Vision for Holistic Technologies, Production System and Management Models.

**Practice sessions:** To discuss the conduct as an engineer or scientist.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. R.R. Gaur, R. Asthana, G.P. Bagaria, A Foundation Course in Human Values and Professional Ethics, 2<sup>nd</sup> revised edition, Excel Books, New Delhi, Reprint 2019.
2. A N Tripathy, Human Values, New Age International Publishers, 3<sup>rd</sup> edition ,New Delhi, 2019.

**REFERENCES:**

1. E G Seebauer & Robert L.Berry, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press, 2000.
2. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd, Reprint 2011.
3. Mike Martin and Roland Schinzinger “Ethics in Engineering” McGraw Hill, New York, 4<sup>th</sup> edition, Reprint 2017.
4. Charles E. Harries, Michael S. Protchard and Michael J. Rabins, “Engineering Ethics- concepts and Cases”, Thomson Learning, 2000.
5. S.K. Chakraborty and Dabangshu Chakraborty, “Human Values and Ethics: Achieving Holistic Excellence”, ICFAI University Press, 2006.

**OUTCOMES:****AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : UNIVERSAL HUMAN VALUES										Course Code : 20HS301					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
C205.1	Explain the significance of value inputs in a classroom and summarize human aspirations.										I	AD	6,7,8,9,10,12	-	
C205.2	Distinguish between Values & Skills to ensure happiness and prosperity.										I	AD	6,7,8,9,10,12	-	
C205.3	Identify the synchronization between Thyself & the Body to ensure competency of an individual										II	AD	6,7,8,9,10,12	-	
C205.4	Generalize the role of a human being in ensuring harmony in society and nature.										III	AD	6,7,8,9,10,12	-	
C205.5	Distinguish between ethical and unethical practices and analyze harmonious social environment.										IV	AD	6,7,8,9,10,12	-	
C205.6	Assess the importance of value based life and evaluate the role of professional ethics.										V	AD	6,7,8,9,10,12	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C205.1	-	-	-	-	-	3	2	3	2	2	-	1	-	-	-
C205.2	-	-	-	-	-	3	2	3	2	2	-	1	-	-	-
C205.3	-	-	-	-	-	3	2	3	2	2	-	1	-	-	-
C205.4	-	-	-	-	-	3	2	3	2	2	-	1	-	-	-
C205.5	-	-	-	-	-	3	2	3	2	2	-	1	-	-	-
C205.6	-	-	-	-	-	3	2	3	2	2	-	1	-	-	-

**20ME3L1**

**STRENGTH OF MATERIALS LABORATORY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**OBJECTIVES:**

- To understand the fundamental modes of loading of the structures
- To measure loads, displacements and strains.
- To obtain the strength of the material and stiffness properties of structural elements
- To study the mechanical properties of materials when subjected to different types of loading.
- To understand the hardening and tempering process

**PRE-REQUISITE: NIL**

**LIST OF EXPERIMENTS**

1. Tensile test
2. Double shear test
3. Torsion test
4. Impact test
5. Strain Measurement using Single and Tri axial strain gauges.
6. Hardness test - Brinell Hardness Number
7. Hardness test - Rockwell Hardness Number
8. Deflection test on beams
9. Compression test on helical springs
10. Effect of hardening- Improvement in hardness and impact resistance of steels.
11. Tempering- Improvement Mechanical properties Comparison
  - (i) Unhardened specimen and
  - (ii) Quenched Specimen Simulation of rectifier circuits using PSIM/SIMULINK

**TOTAL: 45 PERIODS**

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	Universal Tensile Testing machine with double shear attachment	1
2	Torsion Testing Machine	1
3	Impact Testing Machine	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads	1
7	Muffle Furnace	1
8	Rosette strain gauge	1
9	Metallurgical Microscope	1
10	Disc Polishing Machine	1

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

CourseName: STRENGTH OF MATERIALS LABORATORY											CourseCode: 20ME3L1			
CO	CourseOutcomes										EXP	K-CO	POs	PSO
C207.1	Explain the concept of determining stresses and strains from the member forces.										1	K3	1,2,3,5	1,2
C207.2	Apply the basic concepts and effects of axial loads, shear, and torsion on structural components.										2,3,4,5	K3	1,2,3,8,9	1,2
C207.3	Determine the young's modulus of beams by means of deflection of beam experiments										6	K3	1,2,3,8,9	1,2
C207.4	Calculate the hardness of different materials by means of Brinell and Rockwell hardness experiments										7,8	K3	1,2,3,10	1,2
C207.5	Calculate the modulus of rigidity and stiffness of spring by means of open coil and closed coil experiments										9,10	K3	1,2,3	1,2
C207.6	Calculate the hardness and Physical insight into the behaviour materials by means of hardening and tempering experiments.										11,12	K3	1,2,3,10	1,2
CO-PO Mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C207.1	3	2	1	-	1	-	-	-	-	-	-	-	2	1
C207.2	3	2	1	-	-	-	-	-	-	-	-	-	2	1
C207.3	3	2	1	-	-	-	-	1	2	-	-	-	2	1
C207.4	3	2	1	-	-	-	-	-	-	2	-	-	2	1
C207.5	3	2	1	-	-	-	-	-	-	-	-	-	2	1
C207.6	3	2	1	-	-	-	-	-	-	2	-	-	2	1

<b>20ME3L2</b>	<b>FLUID MECHANICS AND MACHINERY LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**OBJECTIVES:**

- To determine the coefficient of discharge for Orifice meter and Venturimeter.
- To measure rate of flow using rotameter.
- To study the performance characteristics of various hydraulic pumps.
- To conduct performance tests in hydraulic turbines.
- To gain practical knowledge about friction factor.

**PRE-REQUISITE: NIL****LIST OF EXPERIMENTS**

1. Determination of coefficient of discharge for Orifice meter.
2. Determination of coefficient of discharge for Venturimeter
3. Determination of rate of flow using Rotameter and its calibration.
4. Performance characteristics of Centrifugal pump
5. Performance characteristics of Submergible pump.
6. Performance characteristics of Reciprocating pump
7. Performance characteristics of Gear pump.
8. Performance characteristics of Pelton turbine.
9. Performance characteristics of Francis turbine.
10. Performance characteristics of Kaplan turbine.
11. Determination of friction factor for flow through pipes.

**TOTAL: 45 PERIODS****LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	Orifice meter	1
2	Venturimeter	1
3	Rotameter	1
4	Centrifugal pump	1
5	Submergible pump.	1
6	Reciprocating pump	1
7	Gear pump.	1
8	Pelton turbine.	1
9	Francis turbine.	1
10	Kaplan turbine.	1
11	Pipe friction apparatus	1

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

CourseName: FLUID MECHANICS AND MACHINERY LABORATORY		CourseCode: 20ME3L2			
CO	CourseOutcomes	EXP	K –CO	POs	PSO
C208.1	Determine the coefficient of discharge for Orificemeter and Venturimeter	1,2	K3	1,2,3,8,9,10	1,2,3
C208.2	Determine the rate of flow using Rotameter and calibrate it	3	K3	1,2,3,8,9,10	1,2,3
C208.3	Predict performance characteristics of centrifugal pump and submergible pump.	4,5	K3	1,2,3,8,9,10	1,2,3
C208.4	Predict performance characteristics of reciprocating pump and gear pump.	6,7	K3	1,2,3,8,9,10	1,2,3
C208.5	Predict performance characteristics of turbines.	8,9,10	K3	1,2,3,8,9,10	1,2,3
C208.6	Determine the friction factor for flow through pipes.	11	K3	1,2,3,5,8,9,10	1,2,3

**CO-PO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C208.1	3	2	1	0	-	-	-	2	2	2	-	-	3	2
C208.2	3	2	1	0	-	-	-	2	2	2	-	-	3	2
C208.3	3	2	1	0	-	-	-	2	2	2	-	-	3	2
C208.4	3	2	1	0	-	-	-	2	2	2	-	-	3	2
C208.5	3	2	1	0	-	-	-	2	2	2	-	-	3	2
C208.6	3	2	1	0	1	-	-	2	2	2	-	-	3	2

<b>20AE3L1</b>	<b>MACHINE DRAWING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVES:**

- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems.

**PRE-REQUISITE: NIL****UNIT-I DRAWING STANDARDS & FITS AND TOLERANCES 9**

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning & tolerancing.

**UNIT-II INTRODUCTION TO 2D DRAFTING 9**

- Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.
- Bearings - Bush bearing, Plummer block
- Valves – Safety and non-return valves.

**UNIT - III 3D GEOMETRIC MODELING AND ASSEMBLY 9**

Sketcher - Datum planes – Protrusion – Holes - Part modeling – Extrusion – Revolve – Sweep – Loft– Blend – Fillet - Pattern – Chamfer - Round - Mirror – Section – Assembly

- Couplings – Flange, Universal, Oldham’s, Muff, Gear couplings
- Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints
- Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch
- Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump

**Note:** 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software

**TOTAL: 60 PERIODS****TEXT BOOKS:**

1. Gopalakrishna K.R., “Machine Drawing”, 22<sup>nd</sup> Edition, Subhas Stores Books Corner, Bangalore, 2013
2. N. D. Bhatt and V.M. Panchal, “Machine Drawing”, 48<sup>th</sup> Edition, Charotar Publishers, 2013

**REFERENCES:**

1. Junnarkar, N.D., “Machine Drawing”, 1<sup>st</sup> Edition, Pearson Education, 2004
2. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, “Machine Drawing”, published by Tata Mc GrawHill, 3<sup>rd</sup> edition, 2017
3. S. Trymbaka Murthy, “A Text Book of Computer Aided Machine Drawing”, CBS Publishers, New Delhi, 2008

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>MACHINE DRAWING</b>											Course Code : 20AE3L1				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Select fits, limits and tolerance for engineering applications										1	K2	1,2,7	-	
CO 2	Use the software packages for drafting and modelling										2	K3	1,2,7	-	
CO 3	Create 2D and 3D models of mechanical elements and automotive parts.										3	K4	1,2,7	-	
CO 4	Identify sectional view, assembly and orthographic concepts to draw various parts.										4	K3	1,2,3,7	-	
CO 5	Re-create part drawings and sectional views as per standards										5	K4	1,2,3,7	-	
CO 6	To prepare assembly drawings both manually and using standard CAD packages										5	K4	1,2,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 4	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-

<b>20BS401</b>	<b>STATISTICS AND NUMERICAL METHODS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**OBJECTIVES:**

- This course aims at providing the necessary basic concepts of statistical and numerical methods and give procedures of testing of hypothesis for small and large samples for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To introduce the basic concepts of solving algebraic and transcendental equations and to introduce the numerical techniques of interpolation in various intervals which plays an important role in engineering and technology disciplines.

**PRE-REQUISITE: NIL**

<b>UNIT-I</b>	<b>TESTING OF HYPOTHESIS</b>	<b>12</b>
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.		
<b>UNIT-II</b>	<b>DESIGN OF EXPERIMENTS</b>	<b>12</b>
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - $2^2$ factorial design.		
<b>UNIT - III</b>	<b>SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS</b>	<b>12</b>
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.		
<b>UNIT - IV</b>	<b>INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION</b>	<b>12</b>
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		
<b>UNIT - V</b>	<b>NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS</b>	<b>12</b>
Single step methods : Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods : Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.		

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. Grewal. B.S. ,“Numerical Methods in Engineering and Science” ,Khanna Publishers, New Delhi, 14<sup>th</sup> Edition, 2016.
2. Veerajan.T., “Probability, Statistics and Random Processes”, Tata McGraw Hill, New Delhi , 3<sup>rd</sup> edition, 2009.

**REFERENCES:**

1. Johnson.R.A., Miller, I and Freund J., "Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8<sup>th</sup> Edition, 2015.
2. Burden.R.L and Faires, J.D, "Numerical Analysis", Cengage Learning,9<sup>th</sup>Edition, 2016.
3. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8<sup>th</sup> Edition, 2011.
4. Venkatraman.M.K., "Numerical Methods in Science and Engineering", National Publishing Co., Madras, 5<sup>th</sup> edition , 2000.
5. Subramaniam.N., "Statistics and Numerical Methods", SCM Publication, Reprint 2015.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : STATISTICS AND NUMERICAL METHODS		Course Code : 20BS401			
CO	Course Outcomes	Unit	K –CO	POs	PSOs
C209.1	Apply the concepts of testing of hypothesis for large samples.	I	K3	1,2,3,8,9	1,2
C209.2	Apply t-test, chi-square and F-test for small samples.	I	K3	1,2,3,8,9	1,2
C209.3	Apply the basic concepts of design of experiments in the field of	II	K3	1,2,3,8,9	1,2
C209.4	Solve algebraic and transcendental equations.	III	K3	1,2,3,8,9	1,2
C209.5	Solve numerical differentiation and integration using numerical techniques.	IV	K3	1,2,3,8,9	1,2
C209.6	Apply numerical techniques to solve the partial differential equations with initial and boundary conditions with engineering applications.	V	K3	1,2,3,8,9	1,2

**CO-PO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C209.1	3	2	1					1	1				2	2	
C209.2	3	2	1					1	1				2	2	
C209.3	3	2	1					1	1				2	2	
C209.4	3	2	1					1	1				2	2	
C209.5	3	2	1					1	1				2	2	
C209.6	3	2	1					1	1	3	2	1	2	2	

<b>20HS401</b>	<b>ENVIRONMENTAL SCIENCE AND ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**OBJECTIVES:**

- To study the scope and significance of environment
- To study the interrelationship between living organism and environment
- To know about conservation of biodiversity
- To get a conceptual knowledge on various types of pollution
- To gain knowledge on various natural resources
- To provide knowledge on natural disasters and its management
- To learn social issues such as human welfare, sustainability related to population

**PRE-REQUISITE: NIL****UNIT-I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 6**

Environment – definition, importance, public awareness Ecosystem – concept, structure and function– producers, consumers and decomposers - characteristic features, structure and function of the forest ecosystem and grassland ecosystem. Biodiversity– definition, types - genetic, species and ecosystem diversity – values - consumptive use, productive use, social, ethical, aesthetic and option values – hot-spots of biodiversity –threats to biodiversity: habitat loss, poaching of wildlife – endangered and endemic species of India – Assignment on conservation of biodiversity.

**UNIT-II ENVIRONMENTAL POLLUTION 6**

Definition, causes, effects and control measures of (i) Air pollution (ii) Water pollution (iii) Soil pollution (iv) Marine pollution – role of an individual in prevention of pollution – pollution case studies -Climate change - global warming, acid rain, ozone layer depletion.

**UNIT - III NATURAL RESOURCES 6**

Forest resources: Uses, over-exploitation, deforestation, case studies Water resources: Surface water and ground water - uses, over-utilization, conflicts over water, Conservation of water - rain water harvesting, dams-benefits and problems. Mineral resources: uses,over exploitation, environmental effects of extracting mineral resources, case studies.

**UNIT - IV SOLID WASTE AND DISASTER MANAGEMENT 6**

Solid waste management Introduction, types ,effects on human beings and disposal management. Disaster management Introduction, causes, effects and management of flood, cyclone, earthquake, landslide disasters – case studies- roles and responsibilities of Government and community

**UNIT - V HUMAN POPULATION AND SOCIAL ISSUES 6**

Population growth, population explosion – family welfare programme –women and child welfare – human rights – value education – sustainable development – resettlement and rehabilitation –waste land reclamation – role of information technology in environment and human health- Debate on women and child welfare.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International (P) Ltd, 6<sup>th</sup> Edition, 2018.
2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 3<sup>rd</sup> edition ISBN: 9789352605710, 2017.

**REFERENCES:**

1. Erach Bharucha, “Text book of Environmental Studies”, Universities Press (I) Pvt Ltd, 3<sup>rd</sup> edition, Hyderabad, 2015
2. G. Tyler Miller and Scott E.Spoolman, “Environmental Science”, Cengage Learning India Pvt, Ltd, Delhi, 14<sup>th</sup> edition 2014
3. Gilbert M.Masters, “Introduction to Environmental Engineering and Science”, 2<sup>nd</sup> edition, Pearson Education, 2004

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ENVIRONMENTAL SCIENCE AND ENGINEERING										Course Code : 20HS401				
CO	Course Outcomes									Unit	K – CO	POs	PSOs	
C214.1	Describe the environment, ecosystem and their significances.									I	K2			
C214.2	Explain the threats to biodiversity.									I	K2			
C214.3	Describe the sources, effects, control methods of environmental pollution.									II	K2		-	
C214.4	Explain the knowledge on various natural resources and its effect on environment due to over utilization.									III	K2		-	
C214.5	Describe the disposal techniques of solid waste and record the consequences of natural disasters.									IV	K2		-	
C214.6	Outline the social issues as welfare, sustainability etc., and relate with population growth.									V	K2		-	
CO-PO Mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C214.1	-	-	-	-	-	2	3	-	-	-	-	-	-	-
C214.2	-	-	-	-	-	2	3	-	-	-	-	-	-	-
C214.3	-	-	-	-	-	2	3	-	-	-	-	-	-	-
C214.4	-	-	-	-	-	2	3	-	-	-	-	-	-	-
C214.5	-	-	-	-	-	2	3	-	-	-	-	-	-	-
C214.6	-	-	-	-	-	2	3	-	-	-	-	-	-	-

20AE401

**MECHANICS OF MACHINES**

L	T	P	C
3	0	0	3

**OBJECTIVES:**

- To understand the current & voltage measurements.
- To discuss the measurement techniques for power and energy, power and energy meters are included.
- To understand the resistance and impedance measurements.
- To understand electronic voltmeters and their applications.
- To demonstrate different types of signal generator and give exposure to telemetry techniques.

**PRE-REQUISITE:**

Course Code: 20BS101&amp;20GE202

Course name: Fundamentals of Engineering Mathematics &amp; Engineering Mechanics

**UNIT-I****MECHANISMS****9**

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

**UNIT-II****FRICTION****9**

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

**UNIT - III****GEARING AND CAMS****9**

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains – Simple – Compound gear trains – Epicyclic gear trains – Determination of speed and torque – Cams – Types of cams – Design of profiles – Knife edged – Flat faced – Roller ended followers with and without offsets for various types of follower motions

**UNIT - IV****BALANCING****9**

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

**UNIT - V****VIBRATION****9**

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

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Rattan.S.S, "Theory of Machines", Tata McGraw–Hill Publishing Co., 5<sup>th</sup> edition, 2019
2. Ballaney.P.L, "Theory of Machines", Khanna Publishers, 25<sup>th</sup> edition, 2009.

**REFERENCES:**

1. Rao,J.S and Dukupati, R.V, "Mechanism and Machine Theory", 2<sup>nd</sup> Edition, Wiley Eastern Ltd., 2002.
2. Malhotra, D.R and Gupta, H.C., "The Theory of Machines", Satya Prakasam, Tech.India Publications, 2005.
3. Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press, 3<sup>rd</sup> edition ,2006

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>MECHANICS OF MACHINES</b>											Course Code : <b>20AE401</b>				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Calculate the velocity and acceleration by vector polygons of four bar mechanism, slider crank chain mechanism and simple mechanisms										1	K2	1,2,7	-	
CO 2	Compute the forces and torques involved in friction drives like clutches, belts andropes										2	K2	1,2,7	-	
CO 3	Classify gears and gear trains and compute velocity ratio.										3	K2	1,2,7	-	
CO 4	Analyse various types of cam and followers with different kinds of follower motion										4	K3	1,2,3,7	-	
CO 5	Determine balancing mass for rotating and reciprocating mass systems.										5	K2	1,2,3,7	-	
CO 6	Understand the various principles of vibrations of different systems										5	K2	1,2,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 4	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-

<b>20AE402</b>	<b>AUTOMOTIVE CHASSIS AND TRANSMISSION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the basic knowledge about various vehicle frames, front axles, steering systems.
- To evaluate the working principles of both conventional and independent suspension system.
- To demonstrate working principle of braking system used in automobile.
- To recognize the construction and working principle of drive line, final drive and differential systems
- To understand the concept, construction and principle of automatic transmission systems.
- To review the knowledge about the constructional feature of rear axle, wheels and tyres.

**PRE-REQUISITE: NIL**

**UNIT-I CHASSIS AND STEERING SYSTEM 9**

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Constructional details and materials for frames. Steering Geometry, Castor, Camber, King Pin Inclination and Toe-in, Toe-out, Slip Angle, Over-Steer and Under-Steer, Ackerman's Steering Mechanisms, Steering Linkages, radius rods and stabilizers, Types of Steering Gear boxes, Reversible and Irreversible Steering, Power-Assisted Steering.

**UNIT-II SUSPENSION SYSTEM 9**

Functions of Suspension System, Active and semi-active, Types of Suspension Springs - Single Leaf, Multi-Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro - Gas , elastic Spring Systems, Boggy suspension system, Independent Suspension System, Shock Absorbers.

**UNIT - III BRAKING SYSTEM 9**

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Braking Torque, Effect of Weight Transfer during Braking, Constructional Details - Drum Brake & Disc Brake, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power- Assisted Braking System, Servo Brakes, Retarders, Anti-Lock Braking System , Regenerative braking system, Exhaust braking system.

**UNIT - IV TRANSMISSION AND DRIVE LINE 9**

Requirement of transmission system, Clutches- Types and construction, Types of Transmission – Chain, Belt and gear drives, Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox. Automatic transmission – Fluid coupling, Torque converter, planetary gear trains, CVT. Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, Propeller Shaft, Universal Joints, Constant Velocity Joints, Front Wheel drive, Multi-axle vehicles, Differential - principle and types, Non-Slip differential, Differential locks.

**UNIT - V AXLES AND WHEELS 9**

Types of Front Axles and Stub Axles, Types of Loads acting on drive axles, Full – Floating, Three- Quarter Floating and Semi-Floating Axles, Axle Housings. Wheels - Rims – Types and constructional details, Tyres- Types, specification and constructional details.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Heinz Hazler, "Modern Vehicle Technology", Butterworth, London, 2<sup>nd</sup> edition, 2005.
2. Newton Steeds and Garret "Motor Vehicles", 13<sup>th</sup> Edition, Butterworth, London, 2005.
3. R.K. Rajput, "A Text-Book of Automobile Engineering", Laxmi Publications Pvt. Ltd, 1<sup>st</sup> edition, 2007.

**REFERENCES:**

1. Tim Gilles, "Automotive Chassis-Brakes, Steering and Suspension", Thomson Delmer Learning, 2008.
2. Jornsens Reimpell, Helmut Stoll, "Automotive Chassis: Engineering Principles", Elsevier, 2<sup>nd</sup> edition, 2001.
3. Heldt.P.M, "Automotive Chassis", Chilton Co., New York, 1990

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: AUTOMOTIVE CHASSIS AND TRANSMISSION											Course Code : 20AE402				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Outline the construction details of various automotive Chassis Frame layouts.										1	K2	1,2,7	-	
CO 2	Explain the functions of steering system and components										2	K2	1,2,7	-	
CO 3	Distinguish various types of suspension system & brakes.										3	K2	1,2,7	-	
CO 4	Select the appropriate transmission system for various automobiles										4	K3	1,2,3,7	-	
CO 5	Demonstrate the working principle of final drive system.										5	K2	1,2,3,7	-	
CO 6	Choose suitable axles, wheels and tyres for a vehicle.										5	K2	1,2,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 4	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-

<b>20AE403</b>	<b>ENGINEERING METALLURGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To impart knowledge on the structure, properties of various metals and Iron – carbon equilibrium diagram.
- To impart knowledge on heat treatment of metals and properties of metal alloys.
- To impart knowledge on non-metallic materials and testing of materials. So as to identify and select suitable materials for various engineering applications.

**PRE-REQUISITE: NIL****UNIT-I ALLOYS AND PHASE DIAGRAMS 9**

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram.

**UNIT-II HEAT TREATMENT 9**

Definition – Full annealing, stress relief, recrystallisation and spheroidising – normalising – hardening and tempering of steel – Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR – Hardenability: Jominy end quench test – austempering – martempering – Case hardening: carburizing, Nitriding, cyaniding and carbonitriding – Flame and Induction hardening.

**UNIT - III FERROUS AND NON-FERROUS METALS 9**

Effect of alloying additions on steel – stainless and tool steels – HSLA, maraging steels – Cast Iron: Grey, white, malleable, spheroidal – alloy cast irons – Copper and copper alloys: Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys – Ni- based super alloys – Materials for automobile components.

**UNIT - IV NON-METALLIC MATERIALS 9**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes) – Engineering Ceramics – Properties and applications of Al<sub>2</sub>O<sub>3</sub>, SiC, Si<sub>3</sub>N<sub>4</sub>, PSZ and SIALON – Composites Classifications: Metal Matrix and FRP – Applications of Composites.

**UNIT - V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9**

Mechanisms of plastic deformation – slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests: Brinell, Vickers and Rockwell hardness tests – Impact test: Izod and Charpy – fatigue and creep failure mechanisms.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Sidney H Avner., “Introduction to Physical Metallurgy”, McGraw-Hill Education, 2<sup>nd</sup> Edition,2017.
2. Williams D Callister, “Material Science and Engineering: An Introduction”, Wiley–India Edition, 6<sup>th</sup> Edition,2006.
3. [Khanna](#). O. P., “Material Science & Metallurgy”, DhanpatRai Publications, 2<sup>nd</sup> Edition, 2014.

**REFERENCES:**

1. Raghavan.V, “Materials Science and Engineering”, Prentice-Hall of India Learning Private Limited, 6<sup>th</sup> Edition, 2015.
2. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials:Properties and Selection”, Pearson Education, 9<sup>th</sup> Edition,2010.
3. Jindal.U.C., “Material Science and Metallurgy”,Pearson Education, 3<sup>rd</sup> Edition, 2012.
4. William F. Smith, JavadHashemi and Ravi Prakash, “Materials Science and Engineering”, McGraw-Hill Education,5<sup>th</sup> Edition, 2013.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ENGINEERING METALLURGY											Course Code : 20AE403				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain alloys and phase diagram, Iron-Iron carbide diagram and steel classification.										1	K2	1,2,7	-	
CO 2	Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.										2	K2	1,2,7	-	
CO 3	Clarify the effect of alloying elements on ferrous and non-ferrous metals.										3	K2	1,2,7	-	
CO 4	Clarify the effect of alloying elements on non ferrous metals.										4	K3	1,2,3,7	-	
CO 5	Differentiate different non-metallic materials.										5	K2	1,2,3,7	-	
CO 6	Summarize the mechanism of plastic deformation and testing mechanical properties										5	K2	1,2,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 4	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-

<b>20AE404</b>	<b>MANUFACTURING PROCESSES AND TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To provide knowledge about the manufacturing of automobile components such as piston, connecting rod, crankshaft, engine block, front axle, frame, body etc., by various types of special casting, machining, metal forming and powder metallurgy process.
- To provide knowledge about the metal joining of automobile components such as front axle, frame, body etc., by various types of welding process.
- To gain knowledge about the manufacturing of automobile plastic components by various types of forming process

**PRE-REQUISITE: NIL**

**UNIT-I CASTING AND WELDING PROCESS 9**

Casting types – procedure to make sand mould – types of core making – moulding tools– machine moulding – Special moulding processes: CO2 moulding – shell moulding – investment moulding –Permanent mould casting – pressure die casting – centrifugal casting – continuous casting – casting defects.

Classification of welding processes – principles of Oxy-acetylene gas welding – A.C metal arc welding – submerged arc welding – tungsten inert gas welding – metal inert gas welding – resistance welding – thermit welding – plasma arc welding - electron beam welding – laser beam welding – defects in welding– Soldering and Brazing.

**UNIT-II CONVENTIONAL MACHINING PROCESS 9**

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe– Basics of CNC machines– CNC Programming

**UNIT - III UN-CONVENTIONAL MACHINING PROCESS 9**

General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining.

**UNIT - IV FORMING AND SHAPING OF PLASTICS 9**

Types of plastics – Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications: Injection moulding, Plunger and screw machines, Blow moulding, Rotational moulding, Film blowing, Extrusion, Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications: Compression moulding, Transfer moulding

**UNIT - V METAL FORMING AND POWDER METALLURGY 9**

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Rao. P. N., “Manufacturing Technology”, Vol. I, McGraw-Hill Education, 5<sup>th</sup> Edition, 2018.
2. Hajra Choudhury, “Elements of Workshop Technology”, Vol. I and II, Media Publishers and Promoters, 2008.
3. Nagendra Parashar. B.S. and Mittal. R.K., “Elements of Manufacturing Processes”, Prentice-Hall of India Private Limited, 2011.

**REFERENCES:**

1. Richard L Little, “Welding and Welding Technology”, McGraw-Hill Education, 2017.
2. “H.M.T. Production Technology – Handbook”, McGraw-Hill Education, 2017.
3. Sharma. P. C., “A Text Book of Production Technology (Manufacturing Processes)”, S. Chand Publishing, 8<sup>th</sup> Edition,2014.
4. Haslehurst. M, “Manufacturing Technology”, Viva Books, 3<sup>rd</sup> Edition, 1998.
5. Serope Kalpakjian, Steven R. Schmid, “Manufacturing Processes for Engineering Materials”, Pearson Education, 6<sup>th</sup> Edition,2018.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: <b>MANUFACTURING PROCESSES AND TECHNOLOGY</b>											Course Code : 20AE404				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Recognize the purpose of casting process and be able to choose the best casting process for a specific product.										1	K2	1,2,7	-	
CO 2	Describe the joining processes. Be able to choose the proper process for different joining cases.										2	K2	1,2,7	-	
CO 3	Compare different material removal processes. Understand the cutting parameters and working condition during cutting.										3	K2	1,2,7	-	
CO 4	Discuss the types of moulding process of plastics and select suitable plastics for different applications.										4	K3	1,2,3,7	-	
CO 5	Demonstrate deformation processes. Be able to choose the best forming process for a specific product.										5	K2	1,2,3,7	-	
CO 6	Understand in depth the Powder Metallurgy processes and their formation mechanism.										5	K2	1,2,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 4	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-

<b>20EC406</b>	<b>FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**OBJECTIVES:**

- To study about the concepts of semiconductor devices such as PN diode, Bipolar and Field effect transistor and some special semiconductor devices.
- To understand the various methods of biasing in BJT, FET.
- To design digital circuits using simplified Boolean functions.
- To understand the architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.

**PRE-REQUISITE: NIL**

**UNIT-I SEMICONDUCTORS 6+6**

Classification of solids based on energy band theory - Intrinsic semiconductors - Extrinsic semiconductors - P type and N type - PN junction - Zener effect - Zener diode characteristics.

**LAB COMPONENT**

1. VI Characteristics of PN Junction Diode
2. VI Characteristics of Zener Diode

**UNIT-II TRANSISTORS AND AMPLIFIERS 6+6**

Bipolar junction transistor - CB, CE, CC configuration and characteristics - Biasing circuits - Class A, B and C amplifiers - Field effect transistor - Configuration and characteristic of FET amplifier - SCR, Diac, Triac, UJT - Characteristics and simple applications.

**LAB COMPONENT**

1. Characteristics of Transistor in CE configuration
2. Characteristics of JFET

**UNIT - III DIGITAL ELECTRONICS 6+6**

Binary number system - AND, OR, NOT, NAND, NOR, XOR, XNOR circuits - Boolean algebra - Flip flops - Half and full adders – Shift registers – Counters..

**LAB COMPONENT**

1. Study of Logic Gates (Basic Gates)
2. Half Adder and Full Adder

**UNIT - IV 8086 MICROPROCESSOR 6+6**

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation..

**LAB COMPONENT**

1. 8 bit Addition, Subtraction
2. Multiplication and Division , Sorting

**UNIT - V INTERFACING AND APPLICATIONS OF MICROPROCESSOR 6+6**

Basic interfacing concepts - Memory Interfacing and I/O interfacing - Applications of microprocessor in Stepper motor control, traffic light control.

**LAB COMPONENT**

1. Stepper Motor Interfacing
2. Traffic Light Control

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. S.Salivahanan, N.Suresh Kumar and A.Vallavaraj, "Electronic Devices and Circuits", Mc Graw Hill, 4<sup>th</sup> Edition, 2018.
2. M.Morris R. Mano and Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL", Pearson Education, 5<sup>th</sup> Edition, 2012.
3. Yu-Cheng Liu and Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", Prentice Hall of India, 2<sup>nd</sup> Edition, 2007.

**REFERENCES:**

1. 1. Millman and C.Halkias, "Integrated Electronics", Tata McGraw Hill, 2007.
2. J.B.Gupta, "Electronic Devices and Circuits", S.K. Kataria & sons, 6<sup>th</sup> edition, 2016.
3. G.K.Kharate, "Digital Electronics", Oxford University Press, 2010.
4. D.P.Leach and A.P.Malvino, "Digital Principles and Applications", Tata Mc Graw Hill, 2011.
5. Douglas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2012.
6. A.K.Ray and K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" Tata McGrawHill, 3<sup>rd</sup> Edition, 2012.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

S.No.	NAME OF THE EQUIPMENT	Qty.
1.	Voltmeters	5 Nos.
2.	Ammeters	5 Nos.
3.	PN Diode, BJT, JFET, Logic Gates, Shift Registers and Counters	1 set.
4.	Digital Logic Trainer Kits	1 No
5.	Breadboards	1 No
6.	Microprocessor Kits – 8086	5 Nos.
7.	D/A Converter Interface	1 No
8.	Stepper Motor Interface	1 No.
9.	CRO	1 No.
10.	Waveform Generator	1 No.
11.	Multimeter	1 No.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS											Course Code : 20EC406				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Discuss the properties of semiconductors with applications to the pn junction and diodes.										1	K2	1,2,7	-	
CO 2	Explain the concepts and working of Bipolar Junction Transistors.										2	K2	1,2,7	-	
CO 3	Explain the concepts and working of Field effect Transistors such as JFET and MOSFET.										3	K2	1,2,7	-	
CO 4	Summarize different types of number systems such as Binary, BCD, Octal and Hexadecimal and conversion between them.										4	K3	1,2,3,7	-	
CO 5	Design combinational and sequential circuits like Adders, Subtractors, Flip-flops, Registers and Counters.										5	K3	1,2,3,7	-	
CO 6	Understand and execute programs based on 8086 microprocessor.										5	K3	1,2,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 4	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-

**20AE4L1****AUTOMOTIVE SYSTEMS LABORATORY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**OBJECTIVES:**

- To assemble and disassemble the parts of an IC engine
- To identify the various components in transmission systems of an automobile.
- To study all the functions of automobile components

**PRE-REQUISITE: NIL****LIST OF EXPERIMENTS**

1. Dismantling and study of Multi-cylinder Petrol Engine
2. Assembling of Multi-cylinder Petrol Engine
3. Dismantling and study of Multi-cylinder Diesel Engine
4. Assembling of Multi-cylinder Diesel Engine
5. Study of petrol engine fuel system
6. Study of diesel engine fuel system
7. Study and measurement of light and heavy commercial Vehicle Frame
8. Study, dismantling and assembling of front and rear Axles
9. Study, dismantling and assembling of differential
10. Study, dismantling and assembling of Clutch
11. Study, dismantling and assembling of Gear Box
12. Study of steering system

**TOTAL: 45 PERIODS****LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	Multi Cylinder Petrol Engine	2 No.
2	Multi Cylinder Diesel Engine	2 No.
3	Petrol and Diesel fuel systems	2 No.Each
4	Heavy duty vehicle chassis frame	1 No.
5	Light duty vehicle chassis frame	1 No.
6	Front axle	2 No.
7	Rear axle	2 No.
8	Differential	2 No.
9	Clutch and Gear box (light duty, heavy duty)	2 No.Each
10	Steering systems with different gearboxes	4 No.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : AUTOMOTIVE SYSTEMS LABORATORY										Course Code : 20AE4L1					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Dismantle and Assemble the automobile chassis and Engine components										1	K3	1,2,3,8,9	-	
CO 2	Identify & differentiate components of SI & CI engines										2	K2	1,2,3,8,9	-	
CO 3	Understand working of braking, steering, clutch, transmission, Suspension systems.										3	K2	1,2,3,8,9	-	
CO 4	Develop skills in Dismantling and assembling of chassis components.										4	K4	1,2,3,8,9	-	
CO 5	Measure the dimensions of various components										5	K4	1,2,3,8,9	-	
CO 6	Correct minor repairs and trouble shoots the breakdowns										5	K4	1,2,3,8,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 6	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-

**20ME4L1 MANUFACTURING TECHNOLOGY LABORATORY**

**L T P C**  
**0 0 3 1.5**

**OBJECTIVES:**

- To practice the various operations that can be performed in Lathe.
- To gain practical knowledge about shaper, drilling, milling machines etc.
- To understand the various grinding processes.
- To measure the cutting forces in Turning/ Milling Process.
- To write CNC programs for Machining processes.

**PRE-REQUISITE: NIL**

**LIST OF EXPERIMENTS**

1. External Thread cutting in lathe
2. Eccentric Turning in lathe
3. Square Head Shaping
4. Spur gear cutting in milling machine
5. Helical gear cutting in milling machine
6. Contour milling in vertical milling machine
7. Angular drilling in Radial drilling machine
8. Gear generation in gear hobbing machine
9. Gear generation in gear shaping machine
10. Surface grinding and Cylindrical grinding
11. Measurement of cutting forces in Milling / Turning Process
13. Simple CNC Programming – Lathe and Milling

**TOTAL: 45 PERIODS**

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S. No.	Name of The Equipment	Quantity
1	Centre Lathes	7
2	Shaper	1
3	Radial Drilling Machine	1
4	Horizontal Milling Machine	1
5	Vertical Milling Machine	1
6	Surface Grinding Machine	1
7	Cylindrical Grinding Machine	1
8	Centerless grinding machine	1
9	Gear Hobbing Machine	1
10	Gear Shaping machine	1
11	Lathe Tool Dynamometer	1
12	Milling Tool Dynamometer	1
13	CNC Lathe	1
14	CNC Milling machine	1

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

<b>Course Name: MANUFACTURING TECHNOLOGY LABORATORY</b>		<b>Course Code: 20ME4L1</b>			
<b>CO</b>	<b>Course Outcomes</b>	<b>EXP</b>	<b>K – CO</b>	<b>POs</b>	<b>PSO</b>
C215.1	Perform various operations in Lathe.	1,2	K3	1,2,3,5,8,9,10,12	1,2,3
C215.2	Perform shaping, drilling and milling operations	3,4,6,7	K3	1,2,3,5,10,12	1,2,3
C215.3	Generate gear profile using milling, gear hobbing and gear shaping machines.	5,8,9	K3	1,2,3,5,8,9,10,12	1,2,3
C215.4	Use grinding machine for surface finishing operations on simple parts	10	K3	1,2,3,5,8,9,10,12	1,2,3
C215.5	Calculate cutting forces using cutting tool dynamometer in Turning/ Milling Process	11	K3	1,2,3,5,8,9,10,	1,2,3
C215.6	Develop CNC programming for the simple components produced in CNC lathe and CNC milling	12	K3	1,2,3,5,8,9,10,12	1,2,3

**CO-PO Mapping**

<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PS O1</b>	<b>PSO 2</b>	<b>PSO3</b>
C215.1	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2
C215.2	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2
C215.3	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2
C215.4	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2
C215.5	3	2	1	-	1	-	-	1	3	1	-	-	2	2	2
C215.6	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2

<b>20ME501</b>	<b>DESIGN OF MACHINE ELEMENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**OBJECTIVES:**

- To understand the procedure for choosing standard data.
- To understand the selection of suitable material properties for the requirement.
- To know about the theories of failure.
- To know about the design procedure for shaft, couplings, joints and springs.
- To understand the theory of lubrication and the design procedure for bearings.

**PRE-REQUISITE:**

*Course Code: 20BS202, 20GE202, 20ME301*

Course Name: Applied Physics, Engineering Mechanics, Strength of materials

**UNIT-I INTRODUCTION 12**

Basic requirements of machine elements, Traditional Design methods, Use of standards in design, Aesthetic and ergonomic considerations in Design, Selection of Materials, Determination of Loads, Deflection in simple machine parts, Modes of failure, Factor of safety, Design against Static Load, Theories of Failure, Design against Fluctuating loads, Fatigue failure theories.

**UNIT-II DESIGN OF SHAFTS AND COUPLINGS 12**

Shaft materials, Design of solid and hollow shafts on strength and torsional rigidity basis, Types of keys, Design of square, flat and Kennedy keys, Design of splines, Design of Couplings - Rigid and flexible couplings.

**UNIT - III DESIGN OF SPRINGS AND POWER SCREWS 12**

Springs: Types of springs, Terminology of helical spring, Styles at end, series and parallel connection-exponential relationship Spring material, Design of helical, concentric, multi leaf Springs against variable loading, Surge in springs. Power screws: Forms of threads, Terminology, Torque requirement, self-locking, Design of power screw.

**UNIT - IV DESIGN OF JOINTS 12**

Threaded joints, Screw threads –Terminology, ISO metric, Bolted joint– Simple analysis and eccentrically loaded. Welded joints - Butt, parallel fillet and transverse fillet welds - Welded joints subjected to axial and eccentric load, bending and torsional moment. Types of rivet heads, rivet materials, Types of failure, Longitudinal buttjoint, circumferential lap joint, eccentrically loaded riveted joint for boiler shells.

**UNIT - V DESIGN OF BEARINGS 12**

Rolling contact bearings – types, selection, static and dynamic load carrying capacity, Design for cyclic loads and speeds, Reliability of bearings, bearing failure – causes and remedies. Sliding contact bearing – basic modes of lubrication, Petroff's equation, Mckee's investigation, Bearing design – selection of parameters, bearing construction, bearing materials, Lubricating oils, selection of lubricants, bearing failure – causes and remedies. Comparison of rolling and sliding contact bearings.

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005.

**REFERENCES:**

1. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw- Hill Book Co. (Schaum's Outline), 2010
3. Bernard Hamrock, Steven Schmid, Bo Jacobson, "Fundamentals of Machine Elements", 2<sup>nd</sup> Edition, Tata McGraw-Hill Book Co., 2006.
4. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
5. Ansel Ugural, "Mechanical Design – An Integral Approach", 1<sup>st</sup> Edition, Tata McGraw-Hill Book Co, 2003.
6. Ganesh Babu, Sridhar, "Machine Design" Tata McGraw-Hill Education, 2<sup>nd</sup> Edition 2010.

**OUTCOMES:****AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : DESIGN OF MACHINE ELEMENTS										Course Code : 20ME501					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Design the given machine component for static and fluctuating loads.										1	K2	1,2,3,4,10,	-	
CO 2	Design a shaft/ coupling for a given application.										2	K2	1,2,3,4,10,	-	
CO 3	Design a suitable spring under various loading conditions.										3	K2	1,2,3,4,10,	-	
CO 4	Design a suitable joint the given application.										4	K2	1,2,3,4,10,	-	
CO 5	Design suitable sliding contact bearing for the given application.										5	K2	1,2,3,4,10,	-	
CO 6	Select suitable rolling contact bearings from data book.										5	K3	1,2,3,4,10,	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	1	-	-	-	-	-	2	-	1	-	-	-
CO 2	3	3	3	1	-	-	-	-	-	2	-	1	-	-	-
CO 3	3	3	3	1	-	-	-	-	-	2	-	1	-	-	-
CO 4	3	3	3	1	-	-	-	-	-	2	-	1	-	-	-
CO 5	3	3	3	1	-	-	-	-	-	2	-	1	-	-	-
CO 6	3	3	3	1	-	-	-	-	-	2	-	1	-	-	-

<b>20AE501</b>	<b>AUTOMOTIVE ELECTRICAL AND ELECTRONICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the need for storage batteries.
- To understand the need for starter motor and alternator in the vehicle.
- To explain the different types of ignition systems
- To recognize different electrical wiring diagrams used
- To list common types of sensor and actuators used in vehicles.

**PRE-REQUISITE:**

**Course Code: 20EC406**

**Course Name: Fundamentals of Automotive Electronics**

<b>UNIT-I</b>	<b>TYPES OF BATTERIES</b>	<b>9</b>
	Principle and construction of lead acid battery, Nickel-Cadmium battery, Lithium ion battery, Nickel metal hydride battery, Sodium sulphur battery and Aluminium air battery. Characteristics of battery, battery rating, capacity and efficiency, various tests on battery, Battery — charging techniques, maintenance of batteries	
<b>UNIT-II</b>	<b>STARTING AND CHARGING SYSTEM</b>	<b>9</b>
	Requirements of starter motor, starter motor types, construction and characteristics, starter drive mechanisms, starter switches and solenoids, charging system components, Integrated alternator-starter. Generators and alternators - types, construction and characteristics, voltage and current regulation, charging circuits.	
<b>UNIT - III</b>	<b>IGNITION SYSTEMS</b>	<b>9</b>
	Components and working of battery coil and magneto–ignition system, electronic ignition system, capacitive discharge ignition system, distributor less ignition system, digital ignition system, direct ignition system, ignition triggering devices, centrifugal and vacuum advance mechanisms. Spark plug — Construction, working and types	
<b>UNIT - IV</b>	<b>WIRING, LIGHTING AND FUEL SUPPLY SYSTEMS</b>	<b>9</b>
	Automotive wiring, insulated and earth return system, Head lamp and Indicator lamp details, anti dazzling and dipper details, electrical feed pump, electronic fuel injection systems.	
<b>UNIT - V</b>	<b>INSTRUMENTS AND SENSORS</b>	<b>9</b>
	Theory and constructional details of dash board instruments and their sensors like Speedometer, odometer, fuel level Indicator, oil pressure and coolant temperature indicators, horns and wiper mechanisms- Introduction to modern driver information systems. Types of sensors — oxygen sensor, hotwire anemometer sensor, vehicle speed sensor, detonation sensor, accelerometer sensor, crank position sensor.	

**TOTAL: PERIODS**

**TEXT BOOKS:**

1. Kholi .P.L. “Automotive Electrical Equipment”, Tata McGraw-Hill co ltd, NewDelhi, First Edition, 2017
2. Robert Bosch, “Automotive Handbook”, Bently Publishers, 9th edition, 2014.
3. Crouse W.H. “Automobile Electrical Equipment”, Tata McGraw Hill Book,NewYork, 10<sup>th</sup> edition 2017.

**REFERENCES:**

1. Judge A.W, “Modern Electrical Equipments of Automobiles”, Chapman & Hall,London 2004.
2. Young, A.P. and Griffith, S.L., “Automobile Electrical Equipments”, ELBS and NewPress, 2004.
- 3 Tom Denton, “Automotive Electrical and Electronic Systems”, Burlington, Elsevier Butterworth-Heinemann, 2004.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: AUTOMOTIVE ELECTRICAL AND ELECTRONICS										Course Code : 20AE501					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the working principle, charging techniques and maintenance of batteries.										1	K2	1,2,3,7	-	
CO 2	Explain the charging and starting systems.										2	K2	1,2,3	-	
CO 3	Explain basic concepts of ignition systems.										3	K2	1,2,3	-	
CO 4	Differentiate the different wiring and lighting systems.										4	K2	1,2,3	-	
CO 5	Explain the working of different instruments used in automobile.										5	K2	1,2,3,7	-	
CO 6	Identify sensors for various applications in vehicle control systems										5	K2	1,2,3,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	1	-	-	-	1	-	-	-	-	-	-	-	-
CO 6	3	2	1	-	-	-	1	-	-	-	-	-	-	-	-

<b>20AE502</b>	<b>VEHICLE DESIGN DATA AND CHARACTERISTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To collect important technical specifications of an automobile from Technical notes, research publications and journals.
- To calculate and tabulate various vehicle performance parameters and design parameters.
- To draw performance curves using the vehicle data.

**PRE-REQUISITE:****Course Code: 20AE402****Course Name : Automotive Chassis and Transmission****UNIT-I INTRODUCTION 9**

Assumptions to be made in designing a vehicle, Range of values for Gross Vehicle Weight, Frontal Area, maximum speed, maximum acceleration, gradeability in different gears, Basics of Automobile Design, Design variables and operating variables affecting performance and emission.

**UNIT-II RESISTANCE TO VEHICLE MOTION AND POWER ESTIMATION 9**

Calculation, Tabulation and Plotting of Curves for Air and Rolling Resistances at various vehicle speeds, Calculation and Plotting of Driving force, Power requirement for different loads and acceleration, Maximum Power calculation.

**UNIT - III ENGINE PERFORMANCE CHARACTERISTICS 9**

Calculation, Tabulation and Plotting of Torque and Mechanical Efficiency for different vehicle speeds, Interpolation of Pressure – Volume diagram, Calculation of frictional Mean Effective Pressure, Calculation of Engine Cubic Capacity, Bore and Stroke Length.

**UNIT - IV VELOCITY, ACCELERATION AND TURNING MOMENT 9**

Connecting rod length to Crank Radius Ratio, Plotting of Piston Velocity and Acceleration against Crank Angle, Plotting Gas force, inertia force and Resultant force against Crank Angle, Turning Moment and Side Thrust against Crank Angle.

**UNIT - V GEAR RATIOS 9**

Determination of Gear Ratios, Acceleration and Gradability, Typical Problems on Vehicle performance

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. William H. Crouse, "Automotive mechanics" – 10th Edition, Tata Mc,Graw Hill Publications Co. New Delhi, 2017.
2. Giri. N. K., "Automotive Mechanics", Khanna Publishers, 8<sup>th</sup> Edition Reprint, 2014
3. Heldt, P.M., "High Speed Combustion Engines", Oxford and I.B.H. Publishing Co.,Kolkata,2002.

**REFERENCES:**

1. Gupta. R.B., "Automobile Engineering", SathyaPrakashan, 8<sup>th</sup> edition.,2016
2. Ganesan V, "Internal Combustion Engines", Fourth Edition, Tata McGraw Hill, 2017.
3. Heinz Heisler, "Advanced Vehicle Technology", Butterworth-Heinemann, Elsevier,India Edition, 2011

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : VEHICLE DESIGN DATA AND CHARACTERISTICS										Course Code : 20AE502					
CO	Course Outcomes									Unit	K-CO	POs	PSOs		
CO 1	Describe the basic design principle of vehicles.									1	K2	1,2,3,4,9	-		
CO 2	Identify the knowledge to the students about the various resistances acting on the vehicle.									2	K2	1,2,3,4,9	-		
CO 3	Apply the design procedure for plotting the performance curves pertaining to engine.									3	K3	1,2,3,4,9	-		
CO 4	Compute the performance characteristics of IC engines.									4	K3	1,2,3,4,9	-		
CO 5	Calculate the effect of Piston Velocity and Acceleration against Crank angle.									5	K3	1,2,3,4,10	-		
CO 6	Determine the gear ratio of automotive gearbox system.									5	K3	1,2,3,4	-		
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-
CO 2	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-
CO 3	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-
CO 4	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-
CO 5	3	3	3	2	-	-	-	-	1	2	-	-	-	-	-
CO 6	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-

20AE503

**ELECTRIC VEHICLES**

L	T	P	C
3	0	0	3

**OBJECTIVES:**

- To understand the development of EVs from technological, environmental, and societal perspectives.
- To acquire the knowledge on modern electric vehicles (EVs)
- To introduce the fundamental concepts and principles of electric drive train topologies.
- To Model, analyze and design electric vehicles and to understand energy management strategies.

**PRE-REQUISITE: NIL****UNIT-I INTRODUCTION 9**

Basics of vehicles mechanisms, history of electric vehicles (EV), Types of Electric Vehicle, Electric vehicle Architecture: Major components of electric vehicle need and importance of EV, Power/Energy supplies requirements for EV applications, EV advantages and Impacts

**UNIT-II ENERGY SOURCES FOR EV 9**

Energy storage requirements, Battery parameters, Types of Batteries, Modeling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation and ultra-capacitors as energy sources for EV

**UNIT - III ELECTRIC PROPULSION 9**

Electric Propulsion EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives

**UNIT - IV BATTERIES AND AUXILIARIES 9**

Battery parameters. Types and characteristics of EV batteries- Lead Acid, Nickel metal hydride, Lithium-ion Batteries. Battery testing and maintenance; charging schemes. On-board and off-board battery chargers. Battery state-of-charge indicators

**UNIT - V ENERGY MANAGEMENT STRATEGIES AND EMERGING EV TECHNOLOGIES 9**

EV energy management strategies, classification and comparison of various energy management strategies, energy efficiency comparison for various EV variants, Hybrid electric vehicles (HEVs): types, operating modes, control, generator/motor requirements.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Mehrdad Ehsani, YiminGao, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design, CRC Press, New York, Third Edition,2019.
2. S. S. Thipse, “Alternative Fuels”, Jaico Publications, First Edition 2010
3. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals, CRC Press, New York,Second Edition,2003.

**REFERENCES:**

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley & SonsLtd., England, Second Edition,2012.
2. Sandeep Dhameja, Electric Vehicle Battery Systems, Newness, Massachusetts, 2002.
3. Dr Mike Westbrook, M H Westbrook, The Electric Car: Development & Future of Battery,Hybrid & Fuel-Cell Cars, British library Cataloguing in Publication Data, First Edition, 2001

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ELECTRIC VEHICLES										Course Code : 20AE503					
CO	Course Outcomes									Unit	K-CO	POs	PSOs		
CO 1	Explain the history and evolvement of electric & hybrid electric vehicles.									1	K2	1,2,7,8	-		
CO 2	Illustrate the various energy storage technologies for modern EVs, including electric motor drives, energy storage, batteries, charging methods, infrastructure and auxiliary systems.									2	K2	1,2,7,8	-		
CO 3	Design and select electric propulsion system components for EV drive suitability for the desirable performance and control.									3	K2	1,2,7,8,9	-		
CO 4	Apply the various technologies involved in electric motor drives, batteries, charging methods, infrastructure and auxiliary systems.									4	K2	1,2,7,8	-		
CO 5	Model, analyze and design EV drive train with energy management strategies.									5	K2	1,2,7,8,9	-		
CO 6	Explain the emerging technologies such as hybrid electric vehicles (HEVs)									5	K3	1,2,7,8	-		
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	1	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	1	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	1	1	-	-	-	-	-	-
CO 4	2	1	-	-	-	-	2	1	-	-	-	-	-	-	-
CO 5	2	1	-	-	-	-	2	1	1	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	1	-	-	-	-	-	-	-

<b>20MC501</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>CONSTITUTION OF INDIA</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>

**OBJECTIVES:**

- To enable the student to understand the importance of the constitution
- To understand the structure of executive, legislature, and judiciary
- To understand the philosophy of fundamental rights, duties and Emergency Provisions.
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court.
- To understand the central and state relation financial and administrative.

**PRE-REQUISITE: NIL**

**UNIT-I INTRODUCTION 3**

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working)  
-Philosophy of the Indian Constitution-Preamble-Salient Features

**UNIT-II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 3**

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

**UNIT - III ORGANS OF GOVERNANCE 3**

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

**UNIT - IV EMERGENCY PROVISIONS 3**

Emergency Provisions - National Emergency, President Rule, Financial Emergency

**UNIT - V LOCAL ADMINISTRATION 3**

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat Elected officials and their roles- CEO Zila Pachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

**TOTAL: 15 PERIODS**

**TEXT BOOKS:**

1. Rajesh Kumar, Universal's Guide to the Constitution of India. Universal Law Publications, 2016.
2. D.C. Gupta, Indian Government and Politics, Vikas Pub, 2018

**REFERENCES:**

1. H.M. Sreevai, Constitutional Law of India, 4<sup>th</sup> edition in 3 volumes, Universal Law Publication
2. J.C. Johari, Indian Government and Politics, Shoban Lal & Co, 2012.
3. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Rights Guarantees in India, Oxford University Press, 2012.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : CONSTITUTION OF INDIA											Course Code : 20MC501				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain history and philosophy of Indian Constitution.										1	K2	6,8,9,	-	
CO 2	Explain the premises informing the twin themes of liberty and freedom from a civilrights perspective.										2	K2	6,8,9,	-	
CO 3	Explain the powers and functions of Indian government										3	K2	6,8,9,	-	
CO 4	Explain the emergency rules of Indian Constitution.										4	K2	6,8,9,	-	
CO 5	Explain the structure and functions of local administration.										5	K2	6,8,9,	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-
CO 2	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-
CO 3	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-
CO 4	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-
CO 5	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-
CO	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-

<b>20AE504</b>	<b>AUTOMOTIVE FUELS AND LUBRICANTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**OBJECTIVES:**

- To impart knowledge about the manufacture of fuels and lubricants.
- To impart knowledge on lubrication principles and lubricants properties.
- To provide knowledge on testing and additives for fuels.

**PRE-REQUISITE: NIL****UNIT-I THEORY OF LUBRICATION 6**

Engine friction: introduction, total engine friction, effect of engine variables on friction — Lubrication principles: hydrodynamic lubrication, elasto-hydrodynamic lubrication, boundary lubrication, bearing lubrication — Functions of the lubrication system.

**UNIT-II LUBRICANTS 6**

Specific requirements for automotive lubricants — Properties of lubricating oils — Classification of lubricating oils — Additives for lubricants

**UNIT - III MANUFACTURE OF FUELS AND LUBRICANTS 6**

Chemical structure of petroleum — Refining process: thermal cracking, catalytic cracking, blending — Products of refining process — Lubricating oil base stocks — manufacture of finished automotive lubricants —Production of Bio-fuels

**UNIT - IV PROPERTIES AND TESTING OF FUELS 6**

Properties and testing of fuels: relative density, calorific value, flash point, fire point, distillation, vapour pressure, viscosity, cloud and pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion etc.

**UNIT - V COMBUSTION AND FUEL RATING 6**

SI Engines — flame propagation and mechanism of combustion, octane rating, fuel requirements — CI Engine — mechanism of combustion, diesel knock, cetane rating, fuel requirements — Petrol fuel additives and diesel fuel additives.

**LIST OF EXPERIMENTS**

1. Flash and Fire points of petrol and diesel.
2. Aniline Point test of diesel.
3. Reid vapour pressure test.
4. Ash content and Carbon Residue Test.
5. Cloud and Pour point Test.
6. Viscosity Index of lubricants and Fuels by Redwood Viscometer.
7. Viscosity Index of lubricants and Fuels by Saybolt Viscometer.
8. ASTM distillation test of liquid fuels.
9. Drop point of grease and mechanical penetration in grease.

**TOTAL :30 PERIODS****TOTAL: 60 PERIODS****TEXT BOOKS:**

1. Ganesan.V., "Internal Combustion Engines", McGraw-Hill Education, 4<sup>th</sup> Edition, 2017.
2. Mathur. M.L., Sharma. R.P. "A course in Internal Combustion Engines", DhanpatRaiPublication, 2003.
3. Obert. E.F., "Internal Combustion Engines and Air Pollution", Intex Educational Pub,3rd Edition, 1973.

**REFERENCES:**

1. John. B. Heywood., "Internal Combustion Engine Fundamentals", McGraw-Hill Education, 1<sup>st</sup> Edition, 2017.
2. Brame. J.S.S., "Fuel: Solids, Liquid and Gaseous", Palala Press, 2015.
3. Francis. W., "Fuels and Fuel Technology", Vol. I & II, Pergamon, 2016.
4. Hobson. G.D. and Pohl. W., "Modern Petroleum Technology", Elsevier Science & Technology, 4<sup>th</sup> Edition, 1973.
5. Lansdown. A.R., "Lubrication: A practical guide to lubricant selection", Pergamonpress, 1982.
6. Ram Prasad., "Petroleum Refining Technology", Khanna Publishers, 1998.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Flash and fire point apparatus	1
2	Aniline point Apparatus	1
3	Reid vapor pressure test Apparatus	1
4	Carbon Residue Test Apparatus	1
5	Cloud and Pour point Apparatus	1
6	Redwood Viscometer	1
7	Saybolt Viscometer	1
8	ASTM distillation test Apparatus	1
9	Ash content Test Apparatus	1
10	Drop point and penetration Apparatus for grease	1

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : AUTOMOTIVE FUELS AND LUBRICANTS											Course Code : 20AE504				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Illustrate the manufacturing process of fuels and lubricants										1	K2	1,2,7	-	
CO 2	Explain the basic theories of lubrication.										2	K2	1,2,7	-	
CO 3	Describe the properties and functions of lubricants.										3	K2	1,2,7	-	
CO 4	Conduct experiment with fuels and lubricants for finding various properties.										4	K3	1,2,3,7	-	
CO 5	Explain the various additives for fuels to improve the engine performance.										5	K2	1,2,3,7	-	
CO 6	Describe the combustion methodology of automotive fuels.										5	K2	1,2,7	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 4	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	2	1	3	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	-	-	-	-	-	-

<b>20AE5L1</b>	<b>AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY</b>	<b>L 0</b>	<b>T 0</b>	<b>P 4</b>	<b>C 2</b>
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**OBJECTIVES:**

- To understand the working principle of Electrical circuits in automobile.
- To evaluate the working principle of Battery, and starter motor.
- To understand the working principle of auxiliary systems used in automobiles.
- To understand the use of sensors in an automobile.
- To develop a programming knowledge on Microprocessor

**PRE-REQUISITE:NIL**

**LIST OF EXPERIMENTS**

**a. Electrical Laboratory**

1. Testing of battery
2. Testing of starting systems
3. Testing of charging systems
4. Testing of ignition systems
5. Study of automotive lighting system
6. Adjustment of head lights beam

**b. Electronics Laboratory**

7. Study of rectifiers (with and without filter), logic gates, adder
8. Study of SCR and IC timer
9. Interfacing Sensors like LVDT, Load Cell etc.
10. Interfacing ADC for Data Acquisition
11. Interfacing DAC for Control Application
12. Interfacing A/D converter and simple data acquisition
13. Micro controller programming and interfacing

**TOTAL: 60 PERIODS**

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	Battery, hydrometer, voltage tester	1 No. each
2	Starter motor, regulator, cut-out	1 No. each
3	Distributor, ignition coil, spark plug	1 No. each
4	Auto electrical wiring system	1 No.
5	Rectifiers, filters	15 Nos. each
6	Bread board, Logic gates ICs,	15 Nos. each
7	Amplifier	15 Nos
8	IC timer	15 Nos
9	Data logger	1 No.
10	8085 trainer kit	10 Nos
11	ADC interface board	2 Nos
12	DAC interface board	2 Nos
13	Sensors like RTD, Load cell, LVDT	2 Nos
14	Actuators like stepper motor	2 Nos

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY</b>										Course Code : <b>20AE5L1</b>					
<b>CO</b>	<b>Course Outcomes</b>										<b>Unit</b>	<b>K-CO</b>	<b>POs</b>	<b>PSOs</b>	
CO 1	Explain the working principle of Electrical circuits in automobile.										1	K2	1,2,8	-	
CO 2	Demonstrate the testing and checking of batteries										2	K2	1,2,8	-	
CO 3	Demonstrate the testing and checking of Starter motor and alternator										3	K2	1,2,8	-	
CO 4	Describe the various electrical systems used in automobiles.										4	K2	1,2,8	-	
CO 5	Identify the use of sensors in an automobile.										5	K2	1,2,8	-	
CO 6	Develop a programming knowledge on Microprocessor										5	K3	1,2,8	-	
<b>CO – PO MAPPING</b>															
<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
CO 1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 4	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 5	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-

<b>20HS4L2</b>	<b>PROFESSIONAL COMMUNICATION LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**OBJECTIVES:**

- This course is framed for imparting practical approach in learning and enhancing communication skill among engineering students.
- Students will be able to identify appropriate expressions in speaking and writing.
- Students will also be able to understand the style and perfection of language in reading and listening various contexts of engineering and technology.
- The course will benefit to the students to gain confidence for every day communication, technical presentation, aptitude test and interviews.

**PRE-REQUISITE: NIL**

<b>UNIT-I</b>	<b>LISTENING</b>	<b>6</b>
Listen and takes notes of Lecture, Talks on Engineering and Technology, Developing effective listening skills, barriers to effective listening, Listening self-Introduction Videos.		
<b>UNIT-II</b>	<b>SPEAKING</b>	<b>6</b>
Self-Introduction, Introduce oneself to the audience, Sharing memorable incidents, Individual presentation practice, Introduction to Group Discussion, GD strategies activities to improve GD skills		
<b>UNIT - III</b>	<b>READING</b>	<b>6</b>
Reading Online Blogs, Reading Advertisement in Online, Newspaper archives reading, Reading FAQ's related to job Interview, General awareness of current affairs		
<b>UNIT - IV</b>	<b>WRITING</b>	<b>6</b>
Process Description, Narrating experiences, Creating Email blogs, Review Writing – Books, Movies, and Journals, Job Application Letter, Resume Writing		
<b>UNIT - V</b>	<b>SUMMARIZED ACTIVITIES</b>	<b>6</b>
Reading — cloze exercises, Identifying redundant words, Jargon words, Foreign words, Technical terms		
Writing – Error free sentences, Essay writing on various levels – basic, middle, and advanced, Preparing Job application letter and Resume		
Speaking – Face to face conversation on specific topics, Answering Interview Questions, Panel Interview, Participating in Group Discussions, Technical Presentation		
		<b>TOTAL: 30 PERIODS</b>

**TEXT BOOKS:**

1. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015

**REFERENCES:**

1. Butterfield, Jeff Soft Skills of Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students, Orient Black Swan: Hyderabad, 2016.
3. Raman, Meenakshi and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
4. S. Hariharan et al. Soft Skills. MJP Publishers: Chennai, 2010.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : PROFESSIONAL COMMUNICATION LABORATORY										Course Code : 20HS4L2					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Listen and Respond global English appropriately										1	K 3	9,10,12	-	
CO 2	Participate in group discussions towards placement drive										2	K 3	9,10,12	-	
CO 3	Make effective presentations of technical topics										3	K 3	9,10,12	-	
CO 4	Communicate with effective technological skills										4	K 3	9,10,12	-	
CO 5	Read and Write the context cohesively and coherently and organize ideas logically in workplace situations										5	K 3	9,10,12	-	
CO 6	Attend job interviews and be successful in them										5	K 3	9,10,12	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO 2	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO 3	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO 4	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO 5	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO 6	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-

<b>20AE601</b>	<b>DESIGN OF AUTOMOTIVE ENGINE COMPONENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the various steps involved in the design of automotive engine components.
- To show their knowledge in designing engine components.
- To complete design exercise and arrive at important dimensions of engine components.
- To learn to use standard data and catalogues

**PRE-REQUISITE:****Course Code: 20AE302, 20ME501****Course Name: Automotive Engines, Design of Machine Elements****UNIT-I INTRODUCTION 9**

Engineering materials and their physical properties applied to design, selection of materials, factor of safety, endurance limit, notch sensitivity, Rankine's formula- Tetmajer's formula- Johnson formula- Design of pushrods.

**UNIT-II LIMITS, FITS, TOLERANCES AND SURFACE FINISH 9**

Definitions, types of tolerances and fits, design considerations for interference fits, surface Morphology

**UNIT - III DESIGN OF CYLINDER AND PISTON 9**

Choice of material for cylinder and piston, piston friction, piston slap, design of cylinder, piston, piston pin, piston rings, piston failures, lubrication of piston assembly.

**UNIT - IV DESIGN OF CONNECTING ROD, CRANKSHAFT AND CAM SHAFT 9**

Material for connecting rod, determining minimum length of connecting rod, small end and big end design, shank design, design of big end cap bolts, failures of connecting rod, balancing of I.C. Engines, significance of firing order, material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations, Design of Cam shaft.

**UNIT - V DESIGN OF VALVES AND FLYWHEEL 9**

Design aspects of intake and exhaust manifolds, inlet and Exhaust valves, valve springs, Tappets, valve train, Materials and design of flywheel.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. V.B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Education, 2017.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 9th Edition, Tata McGraw-Hill, 2011.
3. "Design Data Book", PSG College of Technology, Coimbatore

**REFERENCES:**

1. Giri.N.K, "Automobile Mechanics", Khanna Publishers, 8<sup>th</sup> Edition Reprint, 2014
2. R. S. Khurmi and J. K. Gupta: A Text Book of Machine Design, S. Chand & Co. Ltd., New Delhi. Reprint Edition 2006
3. Jain.R.K, "Machine Design", Khanna Publishers, New Delhi, 2005.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : DESIGN OF AUTOMOTIVE ENGINE COMPONENTS											Course Code : 20AE601				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the properties of engineering materials applied to design, selection of materials factor of safety, endurance limit										1	K2	1,2,3,9	-	
CO 2	Design the helical springs										2	K3	1,2,3,10	-	
CO 3	Apply the concepts of design to Cylinder and Piston assembly										3	K3	1,2,3,10	-	
CO 4	Apply the concepts of design to, connecting rod and crank shaft.										4	K3	12,3,10	-	
CO 5	Design the intake and exhaust Valves										5	K3	1,2,3,10	-	
CO 6	Apply the concepts of design to flywheel.										5	K3	1,2,3,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	-	-	-	-	-	1	2	-	-	-	-	-
CO 2	3	3	3	-	-	-	-	-	1	2	-	-	-	-	-
CO 3	3	3	3	-	-	-	-	-	1	2	-	-	-	-	-
CO 4	3	3	3	-	-	-	-	-	1	2	-	-	-	-	-
CO 5	3	3	3	-	-	-	-	-	1	2	-	-	-	-	-
CO 6	3	3	3	-	-	-	-	-	1	2	-	-	-	-	-

<b>20AE602</b>	<b>DESIGN OF AUTOMOTIVE CHASSIS COMPONENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To obtain the clarity on design parameters of vehicle frame and suspension system.
- To distinguish the choice of spring for suspension system
- To design the automotive components like front axle and steering systems
- To understand the various types of clutches and its design
- To design the automotive gear boxes
- To understand the various types of rear axles and its design

**PRE-REQUISITE:**

**Course Code: 20AE402**

**Course Name : Automotive Chassis and Transmission**

**UNIT-I VEHICLE FRAME AND SUSPENSION 9**

Study of loads-moments and stresses on frame members. Design of frame for passenger and commercial vehicle - Design of leaf Springs-Coil springs and torsion bar springs.

**UNIT-II FRONT AXLE AND STEERING SYSTEMS 9**

Analysis of loads-moments and stresses at different sections of front axle. Determination of bearing loads at Kingpin bearings. Wheel spindle bearings. Choice of Bearings. Determination of optimum dimensions and proportions for steering linkages, ensuring minimum error in steering. Design of front axle beam

**UNIT - III CLUTCH 9**

Design of single plate clutch, multi plate clutch and cone clutch. Torque capacity of clutch. Design of clutch components, Design details of roller and sprag type of clutches.

**UNIT - IV GEAR BOX 9**

Gear train calculations, layout of gearboxes. Calculation of bearing loads and selection of bearings. Design of three speed and four speed gearboxes.

**UNIT - V DRIVE LINE AND REAR AXLE 9**

Design of propeller shaft. Design details of final drive gearing. Design details of transaxle and transfer case. Design details of full floating, semi- floating and three quarter floating rear shafts and rear axle housings and design aspects of final drive.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Giri N.K., Automobile Mechanics, Khanna Publications, 8<sup>th</sup> Edition Reprint, 2014.
2. Khurmi R.S. and Gupta J.K., —A Text Book of Machine Design, 14th Edition, Eurasia Publishing House Pvt. Ltd., 2005.
3. Dean Avern, Automobile Chassis Design Book II, 2nd Edition, Kotelian Sky Press, 2016.

**REFERENCES:**

1. V.B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Education, 5<sup>th</sup> Edition Reprint, 2020.
2. Heldt P.M., —Automotive Chassis II, Chilton Book Co., 2012.
3. Julian Happian-Smith, —Introduction to Modern Vehicle Design II, SAE International, 2004.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: DESIGN OF AUTOMOTIVE CHASSIS COMPONENTS											Course Code : 20AE602				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Compute the design considerations for vehicle frames and suspension										1	K3	1,2,3,4,9	-	
CO 2	Design the main dimensions of front axle beam										2	K3	1,2,3,4,10	-	
CO 3	Design the main dimensions of steering system										3	K3	1,2,3,4,9	-	
CO 4	Calculate the design parameters of the various types of clutches										4	K3	1,2,3,4,9	-	
CO 5	Apply the concept of design to the gearbox for vehicles										5	K3	1,2,3,4,10	-	
CO 6	Calculate the design parameters of propeller shaft and rear axles										5	K3	1,2,3,4,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 2	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 4	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 5	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 6	3	2	2	1	-	-	-	-	1	-	-	-	-	-	-

<b>20AE603</b>	<b>METROLOGY AND QUALITY CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To provide the basic principles of measurements.
- To provide knowledge about various methods for measuring different mechanical parameters.
- To impart knowledge on process control charts for variables and attributes.

**PRE-REQUISITE: NIL**

**UNIT-I CONCEPT OF MEASUREMENT 9**

General concept – Generalized measurement system – Units and standards – Measuring instruments: sensitivity, readability, range, accuracy and precision – systematic and random errors – calibration and correction – repeatability – interchangeability – Introduction to Geometric Dimensioning and Tolerancing (GD&T).

**UNIT-II LINEAR, ANGULAR AND FORM MEASUREMENT 9**

Linear measuring instruments: vernier, micrometer, slip gauges and limit gauges– Comparators: mechanical, pneumatic and electrical comparators – Angular measurements: sine bar and bevel protractor – Form measurements: straightness, flatness and roundness measurements.

**UNIT - III MEASUREMENT OF MECHANICAL PARAMETERS 9**

Force, Torque and Power measurement: mechanical, pneumatic, hydraulic and electrical type — Flow measurement: venturimeter, orifice meter, rotameter and pitot tube — Temperature measurement: bimetallic strip, thermocouples, pyrometer and electrical resistance thermometer.

**UNIT - IV STATISTICAL QUALITY CONTROL AND PROCESS CONTROL FOR VARIABLES 9**

Definition of quality – basic concept of quality SQC: benefits and limitation of SQC– Quality assurance – Quality control – Quality cost – Variation in process – causes of variation –theory of control chart – uses of control chart – X bar chart and R chart – Process capability– process capability studies and simple problems.

**UNIT - V PROCESS CONTROL FOR ATTRIBUTES 9**

Control chart for attributes – Control chart for non-conforming – p chart and np chart –Control chart for non-conformities– C and U charts, State of control and process out of control identification in charts, pattern study.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Gupta. I.C., “A Text Book of Engineering Metrology”, Dhanpat Rai Publications, 2018.
2. Douglas. C. Montgomery., “Introduction to Statistical Quality Control”, 8<sup>th</sup> Edition JohnWiley and Sons Inc, 2020.
3. Grant. E and Leavenworth. R., “Statistical Quality Control”, 7<sup>th</sup> Edition McGraw-HillEducation, 2017.

**REFERENCES:**

1. Jain. R.K., “Engineering Metrology”, Khanna Publishers, 2018.
2. Beckwith, Marangoni, Lienhard., “Mechanical Measurements”, 6<sup>th</sup> Edition PearsonEducation, 2013.
3. Bester field. D.H., “Quality Control”, Pearson Education, 2013.
4. Mahajan. M., “Statistical Quality control”, Dhanpat Rai Publications, 2018.  
Stephen B.V and Marcus J.J., “Statistical Quality Assurance Methods for Engineers”, John Wiley and Sons Inc, 2019.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : METROLOGY AND QUALITY CONTROL											Course Code : 20AE603				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Describe the concepts of measurements to apply in various metrological instruments										1	K2	1, 2	-	
CO 2	Explain the principles of linear, angular and form measurement tools used for industrial applications.										2	K2	1,2	-	
CO 3	Discuss various measuring techniques of mechanical properties in industrial applications.										3	K2	1,2	-	
CO 4	Explain the concept of quality related to manufacturing industry.										4	K2	1,2,6	-	
CO 5	Apply the process control for variables concept in an industry.										4	K3	1,2,4,8	-	
CO 6	Apply the process control for attributes concept in an industry.										5	K3	1,2,4,8	-	
<b>CO – PO MAPPING</b>															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	2	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	2	-	-	-	1	-	-	-	-	-	-	-
CO 6	3	2	-	2	-	-	-	1	-	-	-	-	-	-	-

<b>20ME602</b>	<b>FINITE ELEMENT ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To apply knowledge of mathematics, science and engineering to the analysis of simple structures using the finite element method.
- To identify, formulate, and solve engineering problems using the finite element method.
- To perform steady-state heat transfer analysis including the effects of conduction and convection.
- To perform structural analysis of a part to determine its displacements, stress, strain and reactions.
- To study about the theoretical foundation for nonlinear finite element analysis

**PRE-REQUISITE:**

**Course Code: 20ME301, 20ME504**

**Course Name: Strength of materials, Heat and Mass transfer**

**UNIT-I INTRODUCTION 9**  
 Methods to solve engineering problems – past present and future of FEA–Theoretical FEA–Variational (Ritz) method – Weighted residual methods – General procedure of FEA– Types of FEA analysis.

**UNIT-II ONE-DIMENSIONAL STRUCTURAL PROBLEMS 9**  
 One Dimensional Second Order Equations — Discretization –Derivation of Shape functions and Stiffness matrices and force vectors Assembly of Matrices - Solution of solid mechanics problems (Bar and Beams). Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams

**UNIT - III TWO-DIMENSIONAL STRUCTURAL PROBLEMS 9**  
 Second Order 2D Equations involving Scalar and Vector Variable Functions – Variational formulation – Finite Element formulation – 3 noded triangular elements – Shape functions and element matrices and vectors. Equations of elasticity – Plane stress, plane strain and axisymmetric problems — Body forces and temperature effects — Stress and strain calculations.

**UNIT - IV HEAT FLOW PROBLEMS AND ISOPARAMETRIC FORMULATION 9**  
 Steady state heat transfer analysis: one dimensional analysis of a composite walls and fin–Two-dimensional analysis of thin plate  
 Natural co-ordinate systems – Isoparametric elements –Shape functions, stress-strain and strain-displacement relations for isoparametric elements – Numerical integration

**UNIT - V FATIGUE AND NONLINEAR ANALYSIS 9**  
 Introduction to fatigue– various approaches in fatigue analysis– S-N curve – factors affecting fatigue analysis.  
 Introduction to nonlinear analysis – Types of nonlinearity– Stress–strain measures for nonlinear analysis– General FEA procedure for nonlinear static analysis.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd. NewDelhi, 2007.
2. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions (Engineering Mechanics Series), 2018.
3. David V Hutton "Fundamentals of Finite Element Analysis", McGraw-Hill International Editions, 2018.
4. Gokhale Nitin S "Practical Finite Element Analysis" Finite To Infinite edition, 2020.

**REFERENCES:**

1. Cook, Robert.D., Plesha, Michael.E & Witt, Robert.J. "Concepts and Applications of Finite Element Analysis", Wiley Student Edition, 2004.
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice-Hall of India, Eastern Economy Editions.
3. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004
2. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
4. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)
5. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : FINITE ELEMENT ANALYSIS		Course Code : 20ME602			
CO	Course Outcomes	Unit	K-CO	POs	PSOs
CO 1	Determine the mathematical modeling constant for the given governing equation by using variational and weighted residual methods.	1	K3	1,2,3,4,12	-
CO 2	Determine the nodal stresses of the structural components by using one dimensional analysis.	2	K3	1,2,3,4,5,12	-
CO 3	Demonstrate suitable two-dimensional triangular element equation to solve structural problems under plane stress, plane strain and axisymmetric conditions.	3	K3	1,2,3,4,5,12	-
CO 4	Determine the steady state nodal temperature for heat flow problems.	4	K3	1,2,3,4,5,12	-
CO 5	Determine the stress-strain and strain-displacement relations of the 2-dimensional structural problems by using isoparametric elements.	4	K3	1,2,3,4,12	-
CO 6	Explain the FEA procedure for the non linear analysis and various approaches in fatigue analysis.	5	K2	1,2,3,4,12	-

**CO – PO MAPPING**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	-	-	-	-	-	-	-	1	-	-	-
CO 2	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO 3	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO 4	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO 5	3	3	2	1	-	-	-	-	-	-	-	1	-	-	-
CO 6	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-

<b>20MC601</b>	<b>ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>

**OBJECTIVES:**

- Get a knowledge about Indian Culture
- Know Indian Languages, Literature, religion and philosophy and fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

**PRE-REQUISITE:NIL**

**UNIT-I INTRODUCTION TO CULTURE 3**

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

**UNIT-II INDIAN LANGUAGES AND LITERATURE 3**

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

**UNIT - III RELIGION AND PHILOSOPHY 3**

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

**UNIT - IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) 3**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

**UNIT - V EDUCATION SYSTEM IN INDIA 3**

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

**TOTAL: 15 PERIODS**

**REFERENCES:**

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”,
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, 2014

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE		Course Code : 20MC601			
CO	Course Outcomes	Unit	K –CO	POs	PSOs
<b>C320.1</b>	Explain philosophy of Indian culture.	1	K2	-	
<b>C320.2</b>	Distinguish the Indian languages and literature.	2	K2	-	
<b>C320.3</b>	Explain the philosophy of ancient, medieval and modern India.	3	K2	-	
<b>C320.4</b>	Acquire the information about the fine arts in India.	4	K2	-	
<b>C320.5</b>	Know the contribution of scientists of different eras.	5	K2	-	
<b>C320.6</b>	Explain education systems in India	5	K2	-	

<b>20AE604</b>	<b>TWO AND THREE WHEELERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**OBJECTIVES:**

- To acquire knowledge on the construction and working of power train
- To familiarize the drive train of two and three wheelers
- To familiarize with maintenance procedures of engine and subsystems of two and three wheelers.

**PRE-REQUISITE:****Course Code: 20AE302, 20AE402****Course Name: Automotive Engines, Automotive Chassis and Transmission**

<b>UNIT-I</b>	<b>INTRODUCTION</b>	<b>6</b>
Classification & layouts of two wheelers - mopeds, motorcycles, scooters, Classification & layouts of three wheelers - passenger and goods auto rickshaws, two wheeler frames, main frame and types, three wheeler frame and body.		
<b>UNIT-II</b>	<b>TWO WHEELER ENGINES</b>	<b>6</b>
Selection criteria and design considerations for two wheeler engines, Types of engines used in two wheelers, Scavenging and exhaust systems- scavenging pumps, exhaust pipe and header, muffler, Cranking system- basic cranking mechanisms, kick starter system, push starter.		
<b>UNIT - III</b>	<b>TRANSMISSION, STEERING AND SUSPENSION SYSTEMS</b>	<b>6</b>
Clutch- centrifugal clutches, Gear box- constant mesh gear box, sequential gear box, Gear shifting mechanisms - continuously variable transmission, Gear shifting mechanisms-hand operated , foot operated , Final drive- belt, chain and rope drives. Steering column construction- handle bar, types, controls, Front and rear suspensions systems- telescopic suspension.		
<b>UNIT - IV</b>	<b>BRAKES, WHEELS AND TYRES</b>	<b>6</b>
Braking system- drum brakes, disc brakes, Mechanical and hydraulic brake control systems, Spoked wheel, pressed steel wheel, alloy wheels, braking system for auto rickshaws. Tyres-tubed and tubeless tyres.		
<b>UNIT - V</b>	<b>THREE WHEELERS</b>	<b>6</b>
Engines for three wheelers, Drive trains- drive train layout for passenger and loading rickshaws, propeller shaft, differential, Suspension and brakes- rear suspension for passenger and loading rickshaws		

**Practical**

1. Two wheeler chain tension test and adjustment.
2. Servicing and adjustment of clutch assembly for two / three wheeler.
3. Servicing and adjustment of brake assembly for two / three wheeler.
4. Dismantling and assembling of two / three wheeler gear box and finding gear ratios.
5. Determination of turning circle radius of three wheelers.
6. Fuel system diagnostics and adjustment.
7. Electrical accessories diagnostics and adjustment for two / three wheeler.
8. Ignition system diagnostics and adjustment.
9. Performance test of a shock absorber.
10. Study of two wheeler chassis dynamometer.

**Total: 30 Periods****TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. D.U .Panchal, Two and Three Wheeler Technology, New Delhi: PHI Learning Private Ltd,2015.
2. N.K.Giri, Automotive Mechanics, Khanna Publishers, 8<sup>th</sup> Edition Reprint, 2014.
3. P. E. Irving, Motor Cycle Engineering, Temple Press Book, 1992.

**REFERENCES:**

1. R.V. Brayant, Vespa, Maintenance and Repair Series, New Delhi :S.Chand& Co, 1986.
2. R B Lambretta, A Practical Guide to maintenance and repair, New Delhi: S.Chand& Co,1987.
- 3.Encyclopedia of Motorcycling, UK : 20 volume Marshall, Cavensih,1989.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S. No.	NAME OF THE EQUIPMENT	Qty.
1	Two wheeler chassis dynamometer	1 No.
2	Coil spring test rig	1 No.
3	Chain tension test rig	1 No.
4	Shock absorber test rig	1 No.
5	Two-wheeler gearbox	2 Nos.
6	Two-wheeler clutch	2 Nos.
7	Three-wheeler brake assembly	2 Nos.
8	Three-wheeler steering assembly	2 Nos.
9	Three-wheeler gear box	2 Nos.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : TWO AND THREE WHEELERS												Course Code : 20AE604			
CO	Course Outcomes											Unit	K-CO	POs	PSOs
CO 1	Explain the power train and frames of two and three wheelers of different layouts.											1	K2	1,2,3	-
CO 2	Classify the engines for two wheeler and three wheeler.											2	K2	1,2,3	-
CO 3	Explain the clutch and gear box mechanism											3	K2	1,2,3	-
CO 4	Describe the Suspension system.											4	K2	1,2,3	-
CO 5	Categorize the Wheels and Tyres of two wheelers and classify the Braking system.											5	K2	1,2,3,	-
CO 6	Construct the engines and drive trains for three wheelers.											5	K3	1,2,3,	-
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	1	1	-	-	2	-	-	-	-	-	-	-	-	-
CO 6	2	1	1	-	-	2	-	-	-	-	-	-	-	-	-

<b>20AE6L1</b>	<b>COMPUTER AIDED VEHICLE DESIGN LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVES:**

- To develop part models of engine components
- To design the clutch components
- To provide knowledge on the modeling software for automobile components design
- To impart knowledge on assembly drawing of clutch and gearbox using modeling software

**PRE-REQUISITE:****Course Code: 20AE4L1****Course Name: Automotive systems Laboratory****LIST OF ENGINE DESIGN EXPERIMENTS**

1. Modeling of piston, piston pin and piston rings and drawing of these components.
2. Modeling of connecting rod small end and big end, shank design, design of big end cap, bolts and drawing of the connecting rod assembly.
3. Modeling of crankshaft, balancing weight calculations.
4. Development of short and long crank arms, front end and rear end details, drawing of the crankshaft assembly.
5. Design and drawing of flywheel.
6. Ring gear design, drawing of the flywheel including the development of ring gear teeth.
7. Modeling of the inlet and exhaust valves.
8. Modeling of cam and camshaft, cam profile generation, drawing of cam and camshaft.

**LIST OF CHASSIS DESIGN EXPERIMENTS****CLUTCH**

9. Complete design of clutch components.
10. Assembly drawing of clutch using drafting software.

**GEAR BOX**

11. Gear train calculations and Layout of gearbox.
12. Assembly drawing of gear box using drafting software.

**REAR AXLE**

13. Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings

**TOTAL: 60 PERIODS**

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S. No.	NAME OF THE EQUIPMENT	Qty.
1	Computer nodes	15 Nos.
2	Drafting and Modeling Softwares	15 licenses each

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : COMPUTER AIDED VEHICLE DESIGN LABORATORY										Course Code : 20AE6L1					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Apply the modeling software for automobile components design										1	K2	1,2,3,5	-	
CO 2	Design the engine components using modeling software										2	K2	1,2,3,5	-	
CO 3	Design the chassis components using modeling software										3	K2	1,2,3,5	-	
CO 4	Calculate the design parameters of clutch components										4	K2	1,2,3,5	-	
CO 5	Design the types of rear axle shafts and rear axle housings										5	K2	1,2,3,5	-	
CO 6	Draw the assembly drawings of clutch and gear box using modeling software										5	K3	1,2,3,5	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-	1	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	1	-	1	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	1	-	1	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	1	-	1	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	1	-	1	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	1	-	1	-	-	-	-	-	-	-	-	-	-

20AE6L2

**INNOVATION PRACTICES LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To get hands on training in the fabrication of one or more components of a complete working model, designed by the student.
- To gain knowledge about mechanical components and fabrication techniques
- To provide knowledge about the assembling of components and prepare a working model.
- To work as an individual or in a team in development of technical projects.
- To communicate and report effectively project related activities and findings.

**PRE-REQUISITE: NIL**

**GUIDELINE FOR REVIEW AND EVALUATION**

The students in a group of 2 to 4 works on a topic approved by the head of the department and prepare a comprehensive project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A design and fabrication project report is required at the end of the semester. The design and fabrication project work is evaluated based on oral presentation and Viva voce examination is conducted jointly by external and internal examiners appointed by COE

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : INNOVATION PRACTICES LABORATORY											Course Code : 20AE6L2				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Identify and apply the real world and societal importance problems in automobile and its allied area										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 2	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 3	Apply modern engineering tools for solution										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 4	Contribute as an individual or in a team in development of technical projects										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 5	Develop effective communication skills for presentation of project related activities										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 6	Prepare reports and examination following professional ethics										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO-PO Mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 2	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 3	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 4	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 5	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 6	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2

<b>20AE701</b>	<b>INTELLIGENT VEHICLE TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To acquire knowledge on intelligent systems, focusing on those in-vehicle solutions specifically designed to improve driving and travelling energy efficiency.
- To appreciate the role of electronics in providing improved control to a variety of vehicle systems.
- To enable evaluation of appropriate methodologies and be aware of the design and implementation issues of advanced techniques.

**PRE-REQUISITE:**

**Course Code: 20AE501**

**Course Name: Automotive Electrical and Electronics**

**UNIT-I INTRODUCTION TO INTELLIGENT VEHICLE SYSTEMS 9**

Definition, modern trends in Auto industry, various intelligent systems present in the vehicle, Need for IVS, Benefits, Advanced Driver Assistance System-Types/Levels, Next Generation Intelligent Vehicles, General Vehicle Control.

**UNIT-II IOT IN AUTOMOBILES 9**

Developments on IoT in Automotive Sector, Connected Car Services and Applications- Infotainment, Vehicle and Smartphone Integration, Driving Insights- Analytics, On Board Diagnostics, Real Time Driver Monitor, Geo fencing and Speed Monitoring, Stolen Vehicle Tracking, Biometrics Information for Driver Identification, Vehicle Communication- V2V, V2X, V2R, IoT in Intelligent Transportation Introduction to Autonomous Vehicle.

**UNIT - III TRAFFIC SURROUNDINGS 9**

Global Positioning Systems, Geographical Information Systems, Navigation Systems, Automotive Vision System, Road Recognition, Driver Assistance Systems - Connected Vehicles, Autonomous Vehicles.

**UNIT - IV CONNECTED VEHICLE SYSTEMS 9**

Introduction to CVS, Telematics control system architecture -driver information systems, Vehicle -vehicle interaction using TCS, Current trends in auto industry, In-Vehicle Entertainment System – Mirror link, Web link, App link, Apple Car Play, Android Auto. Application: ecall system - design, functions and limitations.

**UNIT - V AUTONOMOUS VEHICLE COMFORT SYSTEMS AND APPLICATIONS 9**

Driver safety systems- ABS, Driver Aid system- ESP, Blind Spot monitoring system, Collision mitigation system, Adaptive Headlamps, Automatic parking system, Eight way seating system, Adaptive cruise control system, Collapsible and tiltable steering column, Lane Departure Warning.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

- 1.A. Perallos, U. Hernandez-jayo, E. Onieva and I. Garcia-Zuazola (Eds.), Intelligent Transport Systems: Technologies and Applications, Wiley publications, 2015.
2. A. Eskandarian (Ed.), Handbook of Intelligent Vehicles, Springer-Verlag London Ltd, 2012.
3. R. K. Jurgen, Navigation and Intelligent Transportation Systems - Progress in Technology, Automotive Electronics Series, Warrendale, PA: SAE International, 2014.

**REFERENCES:**

- 1.H. Cheng, Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation, Berlin: Springer, 2011.
2. P. C. Cacciabue (Ed.), Modelling Driver Behavior in Automotive Environments: Critical Issues in Driver Interactions with Intelligent Transport Systems, Springer-Verlag London Ltd,
3. LjuboVlacic, Michel Parent and Fumio Harashima, Intelligent Vehicle Technologies, utterworth-Heinemann publications, Oxford, 2001.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : INTELLIGENT VEHICLE TECHNOLOGY										Course Code : 20AE701					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Describe the importance of modern trends in vehicle System.										1	K2	1,2,3,10	-	
CO 2	Apply the knowledge for selection of sensor and communication protocols for interfacing sensors.										2	K3	1,2,3,10	-	
CO 3	Apply the knowledge for understanding the traffic information in the surroundings.										3	K3	1,2,3,10	-	
CO 4	Compare the various intelligent systems used in automobiles.										4	K2	1,2,3,10	-	
CO 5	Explain the entertainment features inside the vehicle.										5	K2	1,2,3,10	-	
CO 6	Explain the intelligent systems associated with Autonomous vehicle.										5	K2	1,2,3,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	-	-	-	-	-	-	2	-	-	-	-	-
CO 2	3	3	3	-	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	3	3	-	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	3	3	-	-	-	-	-	-	2	-	-	-	-	-
CO 5	3	3	3	-	-	-	-	-	-	2	-	-	-	-	-
CO 6	3	3	3	-	-	-	-	-	-	2	-	-	-	-	-

<b>20AE702</b>	<b>VEHICLE DYNAMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To know about the application of basic mechanics principles for dynamic analysis of vehicles.
- To analyze road vehicles for their vertical dynamic response to analyze ride, pitch and roll.
- To apply the concept of Longitudinal Dynamics and Lateral Dynamics related to vehicle handling, vehicle control and vehicle stability.

**PRE-REQUISITE:**

Course Code: 20AE401

Course Name: Mechanics of Machines

**UNIT-I CONCEPT OF VIBRATION 9**

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

**UNIT-II TIRES 9**

Tire forces and moments, Tire structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tires. Magic formulae tire model, Estimation of tire road friction. Test on Various road surfaces. Tire vibration.

**UNIT - III VERTICAL DYNAMICS 9**

Human response to vibration, Sources of Vibration. Design and analysis of Passive, Semi active and Active suspension using Quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tire stiffness. Control law for LQR, H-Infinite, Skyhook damping. Air suspension system and their properties.

**UNIT - IV LONGITUDINAL DYNAMICS AND CONTROL 9**

Aerodynamic forces and moments. Equation of motion. Tire forces, rolling resistance, Load distribution for three wheeler and four wheeler. Calculation of Maximum acceleration, Reaction forces for Different drives. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control.

**UNIT - V LATERAL DYNAMICS 9**

Steady state handling characteristics. Steady state response to steering input. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle under side forces. Stability of vehicle on banked road, during turn. Effect of suspension on cornering.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Singiresu S. Rao, "Mechanical Vibrations", 5th Edition, Prentice Hall, 2010
2. Wong. J. Y., "Theory of Ground Vehicles", 3rd Edition, Wiley-Interscience, 2001
3. Rajesh Rajamani, "Vehicle Dynamics and Control", 1st edition, Springer, 2005

**REFERENCES:**

1. Dean Karnopp, "Vehicle Stability", 1st edition, Marcel Dekker, 2004
2. Nakhaie Jazar. G., "Vehicle Dynamics: Theory and Application", 1st edition, Springer, 2008
3. Jan Zuijdijk, "Vehicle dynamics and damping", Author House, 2009

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : VEHICLE DYNAMICS										Course Code : 20AE702					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the concept of Vibration and develop formulations for Degree of Freedom (D.O.F) such as Single D.O.F , Double D.O.F & Multi D.O.F.										1	K3	1,2,3,9	-	
CO 2	Explain the concept of vibration absorber and different vibration measuring instruments.										1	K2	1,2,3,9	-	
CO 3	Apply the concept force and vibration on tires.										2	K3	1,2,3,9	-	
CO 4	Apply the concept of Vertical Dynamics related to suspension systems.										3	K3	1,2,3,9	-	
CO 5	Apply the concept of Longitudinal Dynamics, control and formulating load distribution for three and four wheelers.										4	K3	1,2,3,4,9	-	
CO 6	Apply the Concept of Lateral Dynamics related to vehicle handling, vehicle control and vehicle stability.										5	K3	1,2,3,4,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	-	2	-	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	2	-	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	-	2	-	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	2	-	-	-	-	-	-
CO 5	3	3	2	2	-	-	-	-	2	-	-	-	-	-	-
CO 6	3	3	2	2	-	-	-	-	2	-	-	-	-	-	-

**20AE7L1 ENGINE TESTING LABORATORY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVES:**

- To conduct performance test on the IC engines.
- To conduct the emission test on IC engines.
- To understand the computerized data acquisition system on IC engines.

**PRE-REQUISITE:**

Course Code: 20AE301, 20AE302

Course Name: Applied Thermodynamics, Automotive Engines

**LIST OF EXPERIMENTS**

1. Experimental study on valve timing diagram in 4-stroke engine and 2-stroke cut model.
2. Performance and emission test on two wheeler SI engine
3. Performance and emission test on automotive multi-cylinder SI engine
4. Performance and emission test on automotive multi-cylinder CI engine
5. Retardation test on I.C. Engines.
6. Heat balance test on automotive multi-cylinder SI engine
7. Heat balance test on automotive multi-cylinder CI engine
8. Morse test on multi-cylinder SI engine.
9. Engine cylinder pressure measurement P- $\theta$  and P-V diagrams for IC engine with piezo-electric pick up, charge amplifier, angle encoder and data acquisition system.
10. Motoring test for indicated power

**TOTAL: 60 PERIODS****LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	Hydraulic dynamometer	1 No.
2	Eddy current dynamometer	1 No.
3	Engine test rig with electrical dynamometer	1 No.
4	Single cylinder two stroke cut section engine	1 No.
5	Single cylinder four stroke cut section engine	1 No.
6	Two-wheeler engine test rig.	1 No.
7	Automotive multi cylinder SI engine test rig with heat balance arrangement	1 No.
8	Automotive multi cylinder CI engine test rig with heat balance arrangement	1 No.
9	Emission Measuring Instruments for Petrol & Diesel Engines	1 No.
10	Piezo-electric pick up, Charge Amplifier, Angle Encoder and (DDAS) Digital data acquisition system	1 No. each

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ENGINE TESTING LABORATORY										Course Code : 20AE7L1					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Analyze the performance characteristics of internal combustion engines.										-	K4	1,2,3,4,9	-	
CO 2	Analyze the emission levels of internal combustion engines.										-	K4	1,2,3,4,9	-	
CO 3	Explain the valve timing and port timing diagrams in IC engines.										-	K2	1,2,3,4,9	-	
CO 4	Determine the heat balance test on multi cylinder petrol engines.										-	K3	1,2,3,4,9	-	
CO 5	Determine the heat balance test on multi cylinder diesel engines.										-	K3	1,2,3,4,9,10	-	
CO 6	Understand the computerized data acquisition system on IC engines.										-	K2	1,2,3,4	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-
CO 2	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-
CO 3	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-
CO 4	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-
CO 5	3	3	3	2	-	-	-	-	1	2	-	-	-	-	-
CO 6	3	3	3	2	-	-	-	-	1	-	-	-	-	-	-

<b>20AE7L2</b>	<b>VEHICLE TROUBLE SHOOTING LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVES:**

- To be familiar with Fault diagnosis of Engine.
- To be familiar with Fault diagnosis of transmission.
- To be familiar with Fault diagnosis of brake and suspension.
- To be familiar with Fault diagnosis of Electrical system.

**PRE-REQUISITE:**

Course Code: 20AE302, 20AE402

Course Name: Automotive Engines, Automotive Chassis and Transmission

**STUDY EXPERIMENTS:**

1. Study about Tools and instruments used in the maintenance shop
2. Study and preparation of different statements/records required for the repair and maintenance works.
3. Wheel alignment procedure.

**LIST OF EXPERIMENTS**

1. Minor and major tune up of gasoline and diesel engines
2. Calibration of Fuel pump
3. Engine fault diagnosis using scan tool
4. Fault diagnosis of transmission system
5. Fault diagnosis of driveline system
6. Fault diagnosis of braking system
7. Fault diagnosis of suspension system
8. Fault diagnosis of steering system
9. Fault diagnosis of Electrical system like battery, starting system, charging system, lighting system etc
10. Fault diagnosis of vehicle air conditioning system
11. Practice the following:
  - i. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel play.
  - ii. Brake Bleeding, air bleeding of diesel fuel system.
  - iii. Servicing of differential unit.
  - iv. Adjustment of head lights beam.
  - v. Wheel balancing of tires

**TOTAL: 60 PERIODS**

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT &amp; TOOLS</b>	<b>Qty.</b>
1	Engine Analyzer	1 No.
2	Cylinder compression pressure gauge	1 No.
3	Vacuum gauge	1 No.
4	Spark plug cleaner and tester	1 No.
5	Cam angle and rpm tester	1 No.
6	Tachometer	1 No.
7	Wheel alignment apparatus	1 No.
8	Gas welding equipment	1 No.
9	Tyre remover	1 No.
10	Bearing puller	1 No.
11	Head light alignment gauge	1 No.
12	Service manuals of petrol, diesel engines	1 No: each
13	Cylinder reboring machine	1 No.

14	Valve grinding machine	1 No.
15	Valve lapping machine	1 No.
16	Fuel injection calibration test bench with nozzle tester	1 No.
17	HRD tester, Clamp on meter, Hydrometer	1 No: each
18	Wheel Balancer	1 No.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: VEHICLE TROUBLE SHOOTING LABORATORY		Course Code 20AE7L2			
CO	Course Outcomes	Unit	K-CO	POs	PSOs
CO 1	Understand the Workshop layouts and records	-	K2	1,2,3,8,9	-
CO 2	Understand about the tools and Equipments used in Automotive workshop	-	K2	1,2,3,8,9	-
CO 3	Explain the service of various sub systems in the vehicle	-	K2	1,2,3,8,9	-
CO 4	Explain the service of Electrical system	-	K2	1,2,3,8,9	-
CO 5	Understand the vehicle air conditioning system.	-	K2	1,2,3,8,9	-
CO 6	Understand the maintenance of automotive components like clutch, brake, steering, etc.	-	K2	1,2,3,8,9	-

**CO – PO MAPPING**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-
CO 6	3	3	2	-	-	-	-	1	1	-	-	-	-	-	-

<b>20AE801</b>	<b>VEHICLE BODY ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To impart knowledge in the construction of vehicle.
- To understand the aerodynamic concept and testing
- To be well versed in the design and construction of external body of the vehicles.

**PRE-REQUISITE:**

Course Code: 20AE402  
 Course Name: Automotive Chassis and Transmission

**UNIT-I VEHICLE AERODYNAMICS 9**

Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Windtunnels – Principle of operation, Types. Wind tunnel testing Airflow management test – measurement of various forces and moments by using wind tunnel.

**UNIT-II BUS BODY DETAILS 9**

Types of bus body: based on capacity, distance traveled and based on construction.– Bus body lay out for various types, Types of metal sections used – Regulations – Constructional details: Conventional and integral.

**UNIT - III COMMERCIAL VEHICLE DETAILS 9**

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

**UNIT - IV CAR BODY DETAILS 9**

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car – Visibility-regulations, driver’s visibility, improvement in visibility and tests for visibility. Driver seat design -Car body construction-Variou panels in car bodies. Safety aspect of car body.

**UNIT - V BODY MATERIALS AND BODY REPAIR 9**

Types of materials used in body construction-Steel sheet, timber, plastics, GRP, properties of materials. Hand tools-power tools-panel repair-repairing sheet metal-repairing plastics- body fillers-passenger compartment service- corrosion: Anticorrosion methods, Modern painting process procedure-paint problems

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. James E Duffy, "Body Repair Technology for 4-Wheelers", Cengage Learning, 2009.
2. Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 1998.
3. John Fenton, "Vehicle Body layout and analysis", Mechanical Engg. Publication Ltd., London, 1992.

**REFERENCES:**

1. Braithwaite, J.B., "Vehicle Body building and drawing", Heinemann Educational Books Ltd., London, 1997.
2. Dieler Anselm., The passenger car body, SAE International, 2000
3. Giles, G.J., "Body construction and design", Illiffe Books Butterworth & Co., 1991.
4. John Fenton, "Vehicle Body layout and analysis", Mechanical Engg. Publication Ltd., London, 1992.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: VEHICLE BODY ENGINEERING											Course Code : 20AE801				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Identify the Various forces and moments acting on vehicle using wind tunnel.										1	K2	1,2,3,9	-	
CO 2	Classify bus body and select suitable method for construction.										2	K2	1,2,3,10	-	
CO 3	Evaluate and analyze the different aspects of commercial vehicle body.										3	K2	1,2,3,10	-	
CO 4	Classify car body and identify the car body Parts in a vehicle.										4	K2	1,2,3,9	-	
CO 5	Choose suitable material which can be used in car body, bus Body of an automobile.										5	K2	1,2,3,9	-	
CO 6	Identify and describe various painting process for a Commercial vehicle and tools used for body repairs.										5	K2	1,2,3,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	-	-	-	-	-	2	-	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	-	1	-	-	-	-	-
CO 3	3	2	2	-	-	-	-	-	-	1	-	-	-	-	-
CO 4	3	2	3	-	-	-	-	-	1	-	-	-	-	-	-
CO 5	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 6	3	2	2	-	-	-	-	-	-	1	-	-	-	-	-

**20AE8L1****PROJECT WORK**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>

**OBJECTIVES:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination

**PRE-REQUISITE:**

ALL CORE COURSES &amp; LABORATORIES

**GUIDELINE FOR REVIEW AND EVALUATION**

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 300 PERIODS****OUTCOMES:****AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: PROJECT WORK										Course Code : 20AE8L1					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Identify problems related with automobile domain.										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 2	Comprehend the basic concepts of automotive technology, mechanics, science and mathematics in designing mechanical systems.										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 3	Give solution to the problem among alternatives by applying design and theoretical back ground.										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 4	Estimate/evaluate the cost involvement of the project and document the project work.										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 5	Create, design and develop hardware or software for a specific real world problem.										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO 6	Prepare the project reports and give proper explanation during the presentation and demonstration.										-	K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2,3	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 2	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 3	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 4	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 5	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CO 6	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2

**PROFESSIONAL ELECTIVE – I  
(VI SEMESTER)**

<b>20AE6A1</b>	<b>ADVANCED THEORY OF IC ENGINES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To model and simulate the engine cycle.
- To perform combustion analysis.
- To familiarize instruments used in measurement of IC engines.

**PRE-REQUISITE:**

**Course Code: 20AE302, 20AE504**

**Course Name: Automotive Engines, Automotive Fuels and Lubricants**

**UNIT-I COMBUSTION OF FUELS 9**

Chemical composition and molecular structure of hydrocarbon fuels, combustion reactions and stoichiometry of hydrocarbon fuels - chemical energy and heat of reaction calculations - chemical equilibrium and adiabatic flame temperature calculation, Theory of SI and CI engine combustion — Flame velocity, concepts of burning rate and area of flame front, Fuel spray formation characteristics, spray droplet size, depth of penetration and atomization.

**UNIT-II ENGINE CYCLE ANALYSIS 9**

Ideal air, fuel air cycle and actual cycle analysis, Progressive combustion analysis in SI engines, Parametric studies on work output, efficiency and other engine performance.

**UNIT - III COMBUSTION MODELLING 9**

Basic concepts of engine simulation - Governing equations, Classification of engine models- Thermodynamic models for Intake and exhaust flow process - Quasi steady flow - Filling and emptying - Gas dynamic Models, Thermodynamic and fluid mechanic based cylinder models for SI engine and CI engines.

**UNIT - IV NON CONVENTIONAL ENGINES 9**

Adiabatic and L.H.R. engine, Variable compression ratio engine and its use in engine research, Wankel rotary combustion engine, Dual fuel engine concept for multi fuel usage in CI engines - performance studies on dual fuel engine, Free piston engine, Stratified charge and lean burn engines. Locomotive and marine engines.

**UNIT - V COMBUSTION ANALYSIS IN IC ENGINES 9**

Photographic studies of combustion processes - Analysis of Pressure crank angle diagrams in SI and CI engines. Knock study for Pressure crank angle histories, Apparent heat release rate and Wiebe's law analysis for combustion, Calculation of Ignition delay and combustion duration, Hot wire and laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Ganesan.V, “Internal combustion engines ”,5<sup>th</sup> edition ,Tata Mcgraw Hill Publishing company.,2017.
2. Heywood J.B, “Internal Combustion Engine Fundamentals”, 2nd edition, McGraw HillBook Co., 2018.
3. Ramalingam K.K, “Internal Combustion Engine”, 3rd edition, Scitech publications, Chennai,2016.

**REFERENCES:**

1. V.Sajith,Shijo Thomas . “Internal combustion engines –Oxford publications, 2017.
- 2.Ganesan.V, “Internal Combustion Engines”, 4th edition, Tata McGraw Hill Publishing Co.,2017
2. Mathur R.B and Sharma R.P., “Internal Combustion Engines”, DhanpatRai& Sons 2014.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : ADVANCED THEORY OF IC ENGINES											Course Code : 20AE6A1				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain about the heat of reaction and stoichiometry of hydrocarbon fuels.										1	K2	1,2,3,9	-	
CO 2	Describe the concept of adiabatic flame temperature of constant pressure and volume combustion process.										2	K2	1,2,3,9	-	
CO 3	Compute the Ideal and actual fuel air cycles.										3	K2	1,2,3,4,10	-	
CO 4	Apply knowledge in usage of software for simulating the performance of IC engines.										4	K2	1,2,3,4,10	-	
CO 5	Discuss about the various technologies for non-conventional IC engines.										5	K2	1,2,3,10	-	
CO 6	Describe the various combustion analyses of IC engines										5	K2	1,2,3,4,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	-	-	-	-	1	2	-	-	-	-	-
CO 2	3	3	3	2	-	-	-	-	1	2	-	-	-	-	-
CO 3	3	3	3	2	-	-	-	-	1	2	-	-	-	-	-
CO 4	3	3	3	2	-	-	-	-	1	2	-	-	-	-	-
CO 5	3	3	3	2	-	-	-	-	1	2	-	-	-	-	-
CO 6	3	3	3	2	-	-	-	-	1	2	-	-	-	-	-

<b>20AE6A2</b>	<b>FUNDAMENTALS OF COMBUSTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To acquire the fundamental knowledge of combustion.
- To understand the thermodynamics of combustion.
- To explain the combustion in various fuel sources and combustion aspects in SI and CI Engines

**PRE-REQUISITE:**

**Course Code: 20AE301,20AE504**

**Course Name: Applied Thermodynamics, Automotive Fuels and Lubricants**

**UNIT-I COMBUSTION THERMODYNAMICS 9**

Stoichiometry; first and second laws of thermodynamics applied to combustion; Ignition and combustion in SI engine; Flame travel; turbulent flame propagation; flame stabilization; vaporization; Review of detonation and Diesel knock; effect of various factors; Combustion chambers for SI engines; Combustion in CI engine; Ignition delay and diesel knock; Excess air supply and air motion; Combustion chamber for CI engines- Construction and Performance aspects; M-combustion chamber; latest combustion chamber and technology.

**UNIT-II COMBUSTION OF SOLID FUELS 9**

Drying of solid fuels, devolatilization of solid fuels, stoker-fired boilers, Refuse and biomass fired boilers, Pulverized coal-burning systems, Pulverized coal combustion, Emission from pulverized coal, Problems

**UNIT - III COMBUSTION OF LIQUID FUELS 9**

Spray combustion in furnace, spray formation and droplet behaviour, Gas turbine operating parameters, combustor design, ignition delay, and detonation of liquid fuel sprays

**UNIT - IV COMBUSTION OF GASEOUS FUELS 9**

Review of types of fuels, Types of flames, Energy balance and furnace efficiency, Burner type, Emissions from gas-fired furnaces, Emissions control, Chamber design, Detonation

**UNIT - V FLUIDIZED BED COMBUSTION 9**

Fluidization fundamentals, combustion in bubbling bed, atmospheric fluidized bed combustion systems, circulating fluidized beds, pressurized fluidized bed combustion, problems

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Yunus.A.Cengel- A textbook of Thermodynamics- An Engineering approach,McgrawHill ,Edition 2019 .
2. Mukhopadhyaya,Taylor&Francis -Fundamentals Of Combustion Engineering-CRCPress, 2019 Edition
3. Sara McAllister,Jyh-Yuan Chen,A.Carlos Fernandez –Pello-Fundamentals ofcombustion process, Springer-Edition 2011

**REFERENCES:**

1. Om prakash Gupta-Elements of Fuel and Combustion Technology,Khanna Publishers-Edition 2018.
2. John B.Heywood - Internal Combustion Engine Fundamentals, 2nd Edition-2018  
Kenneth kuan-yunkho Principles of combustion ,John wiley&sons 2005 Edition

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : FUNDAMENTALS OF COMBUSTION											Course Code : 20AE6A2				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the basics concept of combustion thermodynamics.										1	K2	1,2,3,9	-	
CO 2	Compare the phenomenon of combustion in SI and CI engines.										2	K2	1,2,3,10	-	
CO 3	Describe the fundamentals of solid fuel combustion process and its applications.										3	K2	1,2,3,9	-	
CO 4	Identify the liquid fuel combustion process and its applications.										4	K2	1,2,3	-	
CO 5	Describe the combustion process of gaseous fuel.										5	K2	1,2,3,9	-	
CO 6	Summarize the basics of fluidization bed.										5	K2	1,2,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	-	2	1	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	2	1	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	-	2	1	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	2	1	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	-	2	1	-	-	-	-	-
CO 6	3	3	2	-	-	-	-	-	2	1	-	-	-	-	-

<b>20AE6A3</b>	<b>HYBRID AND FUEL CELL VEHICLES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To gain knowledge about electric vehicle and different components of electric vehicle.
- To know the architecture and power plant specifications of hybrid vehicle
- To know the performance parameter of hybrid vehicle.
- To gain Knowledge about fuel cell and types of fuel cell with energy storage systems.

**PRE-REQUISITE:****Course Code: 20AE503****Course Name: Electric vehicles****UNIT-I ELECTRIC VEHICLES TECHNOLOGY 9**

Conceptual illustration, various configurations of EVs, Types of electric motors, Traction motor characteristics, solar panels for vehicle, performance estimation of EVs, Design considerations and sizing of elements, Solar panel for vehicle, advantages, disadvantages, applications

**UNIT-II HYBRID VEHICLE TECHNOLOGY 9**

Hybrid electric drive train, Classification, Operating modes, various architectures of HEVs, Parallel hybrid drive train with torque coupling and speed coupling. Parallel and combined configurations, Mild hybrid-power assist- dual mode- power split mode. Introduction to solar vehicle

**UNIT - III FUEL CELL TECHNOLOGY 9**

Fuel cell working, Fuel cell characteristics- fuel cell types — alkaline fuel cell- proton exchange Membrane; direct methanol fuel cell phosphoric acid fuel cell- molten carbonate fuel cell- solid oxide fuel cell-super and ultra-capacitors- PEM fuel cell vehicles.

**UNIT - IV ENERGY STORAGE TECHNOLOGY IN HYBRID AND FUEL CELL 9**

Fuel cell hydrogen storage systems- Overview of Batteries, Battery basics; lead acid battery, different types of batteries; battery parameters, Characteristics of battery, Selection of battery in EHV, Design consideration of battery: Battery Modeling, Flywheels

**UNIT - V SUBSYSTEMS OF HYBRID AND FUEL CELL VEHICLES 9**

Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles. Steering and Suspension system, Choice of Tires, fuel stack model, control of fuel cell system.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Mehrdad Ehsani, YiminGao, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design, CRC Press, New York, Third Edition,2019.
2. S. S. Thipse, “Alternative Fuels”, Jaico Publications, First Edition 2010
3. IqbalHussain, Electric & Hybrid Vehicles – Design Fundamentals, CRC Press, New York, Second Edition,2003.

**REFERENCES:**

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley & SonsLtd., England, Second Edition,2012.
2. Sandeep Dhameja, Electric Vehicle Battery Systems, Newness, Massachusetts, 2002.
3. Dr Mike Westbrook, M H Westbrook, The Electric Car: Development & Future of Battery,Hybrid & Fuel-Cell Cars, British library Cataloguing in Publication Data, First Edition, 2001

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : HYBRID AND FUEL CELL VEHICLES										Course Code : 20AE6A3					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Identify the need of EVs and HEVs in today’s transportation context										1	K2	1,2,8	-	
CO 2	Compare EV and HEV technology										2	K2	1,2,7,8,9	-	
CO 3	Choose different operating modes of HEV										3	K2	1,2,7,8	-	
CO 4	Explain about energy storage systems.										4	K2	1,2,7,8	-	
CO 5	Explain fuel cell technology for vehicular application										5	K2	1,2,8,9	-	
CO 6	Describe power requirements of fuel cell vehicle.										5	K3	1,2,7,8	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	1	1	1	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 4	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-
CO 5	2	1	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-

<b>20AE6A4</b>	<b>ROBOTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To explain the concepts of industrial robots with respect to its classification, specifications and coordinate systems.
- To study of various types of end effectors for a robot
- Applying the different sensors and image processing techniques in robotics to improve the ability of robots.
- Developing robotic programs for different tasks and analyzing the kinematics motion of robot.
- Implementing robots in various industrial sectors and interpolating the economic analysis of robots.

**PRE-REQUISITE:**

**Course Code: 20AE401**

**Course Name : Mechanics of machines**

**UNIT-I INTRODUCTION OF ROBOTICS 9**

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications- Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Payload Robot Parts and their Functions- Need for Robots- Different Applications.

**UNIT-II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9**

Pneumatic Drives- Hydraulic Drives- Mechanical Drives- Electrical Drives- D.C. Servo Motors, Stepper Motors, A.C. Servo Motors- Salient Features, Applications and Comparison of all these Drives, End Effectors- Grippers- Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers.

**UNIT - III SENSORS AND MACHINE VISION 9**

Transducers and Sensors – Sensor categories – Internal sensor: Piezo-electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic position Sensors, External sensor: Touch, Wrist, Slip sensors, Triangulation principles, Structural Lighting approach, Time to flight range. Function of machine vision system – Sensing and Digitizing, Imaging devices – CCD Videocon camera, Lighting techniques. Image Processing and Analysis – Image data reduction – segmentation – Feature extraction – Object recognition.

**UNIT - IV ROBOT PROGRAMMING 9**

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians. Methods of Robot Programming – Robot programming – Lead through – manual – Powered – Robot languages, VAL Programming

**UNIT - V ROBOT ECONOMICS AND APPLICATION 9**

Safety in robotics. Implementation of robots in industries – various steps; Economic analysis of robots – Pay back method – EUAC (Equivalent Uniform Annual Cost Method). Industrial application of robots.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Groover,M.P., Weis,M., Nagel,R.N. and Odrey,N.G., “Industrial Robotics Technology, Programming and Applications”, McGraw-Hill, Int. , Second Edition, 2017
2. Deb, S.R.” Robotics Technology and Flexible Automation”, Tata McGraw-Hill,Second Edition, 2017
3. Klaffer,R.D., Chmielewski, T.A. and Negin,M., “Robotics Engineering – An IntegratedApproach”, Prentice-Hall of India Pvt. Ltd., Second edition, 1989.

**REFERENCES:**

1. Jordanides,T. and Torby,B.J., ,”Expert Systems and Robotics “, Springer –Verlag, NewYork, Reprint, 1991.
2. K.S.Fu, Gonzalez, R.C. and Lee, C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill, Reprint,1987.
3. John J Craig, Introduction to Robotics. Roboticsand Control.Prentice-Hall of India Pvt. Ltd.Second edition , Reprint 2004

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>ROBOTICS</b>		Course Code : 20AE6A4													
CO	Course Outcomes	Unit	K-CO	POs	PSOs										
CO 1	Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors.	1	K2	1,2,8,9	-										
CO 2	Illustrate the different types of robot drive systems as well as robot end effectors.	2	K2	1,2,8,9	-										
CO 3	Apply the different sensors and image processing techniques in robotics to improve the ability of robots.	3	K3	1,2,8,9	-										
CO 4	Develop robotic programs for different tasks and familiarize with the kinematics motions of robot.	4	K3	1,2,8,9	-										
CO 5	Discuss various applications of industrial robot systems	5	K2	1,2,8,9	-										
CO 6	Analyze the Robot economics.	5	K2	1,2,9,11	-										
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	-	-	1	-	2	-	-	-	-

<b>20AE6A5</b>	<b>NON DESTRUCTIVE TESTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.
- To introduce the basic principles, techniques, equipment, applications and limitations of NON DESTRUCTIVE TESTING(NDT) methods such as Visual, Penetrant Testing, Magnetic Particle Testing, Ultrasonic Testing, Radiography, Eddy Current.
- To enable selection of appropriate NDT methods.
- To identify advantages and limitations of non-destructive testing methods
- To make aware the developments and future trends in NDT.

**PRE-REQUISITE: NIL**

**UNIT-I OVERVIEW OF NDT 9**  
 NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT. Visual inspection — Unaided and aided.

**UNIT-II SURFACE NON DESTRUCTIVE EVALUATION METHODS 9**  
 Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

**UNIT - III THERMOGRAPHY AND EDDY CURRENT TESTING 9**  
 Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

**UNIT - IV ULTRASONIC TESTING AND ACOUSTIC EMISSION 9**  
 Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique — Principle, AE parameters, Applications

**UNIT - V RADIOGRAPHY 9**  
 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 - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, Third edition, Reprint, 2019.
2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010
3. Charles, J. Hellier, “ Handbook of Nondestructive evaluation”, McGraw Hill, Second edition, 2012.

**REFERENCES:**

1. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005
3. 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

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : NON DESTRUCTIVE TESTING											Course Code : 20AE6A5				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Describe the various Non Destructive testing methods										1	K2	1,2,8	-	
CO 2	Explain the process of Surface Testing Methods										2	K2	1,2,8,9	-	
CO 3	Apply the Sub Surface Testing methods										3	K2	1,2,8,10	-	
CO 4	Choose the various applications of NDT Tests in Industries.										4	K2	1,2,8,9	-	
CO 5	Identify the types of defects in Industries.										5	K2	1,2,8	-	
CO 6	Characterize the industrial components										5	K3	1,2,8	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	-	2	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	-	2	-	1	-	-	-	-	-
CO 4	2	1	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 5	2	1	-	-	-	-	-	2	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-

<b>20AE6A6</b>	<b>SOLAR AND WIND ENERGY TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar & Wind energy.
- To acquire complete knowledge on availability of possible alternate energy sources

**PRE-REQUISITE: NIL**

**UNIT-I SOLAR ENERGY 9**

Basics of solar energy - Brief history of solar energy utilization - Various approaches of utilizing solar energy- Renewable vs non renewable sources of energy, — Solar Radiation - Terminology, Measurements of Solar Radiation; Solar collectors - Flat Plate and Concentrating Collectors

**UNIT-II SOLAR APPLICATIONS 9**

Direct Thermal Applications, Solar thermal Power Generation, Solar Cells - Fundamentals of Solar Photo Voltaic Cells, Classification, Characteristics, Power Generation & Applications, Solar Refrigeration and Air Conditioning

**UNIT - III WIND MAPPING ANALYSIS AND CHARACTERISTICS OF WIND 9**

Nature of wind — wind structure and measurement - wind power laws - velocity and power duration curves - aero foil - tip speed ratio - torque and power characteristics power coefficients — Betz coefficient.

**UNIT - IV WIND MILL TYPES AND APPLICATIONS 9**

Vertical and Horizontal axis wind mills, Construction and working, Performance, Safety and failure; National Wind energy scenario - potential, installed, economics and environmental aspects. Wind energy storage - wind farms - wheeling and banking

**UNIT - V ALTERNATE ENERGY SOURCES 9**

Tidal energy, Wave Energy, Ocean Thermal energy - Open and Closed OTEC Cycles, Geothermal Energy, Small Hydro energy and conversion techniques; Fuel cell — principle and operation — classification and types. Energy storage — pumped hydro and underground pumped hydro — compressed air - battery - flywheel — thermal.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala "Fundamentals and Applications of Renewable energy" McGraw Hill New Delhi, 2019
2. Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
3. Twidell & Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011

**REFERENCES:**

1. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2015.
2. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010
3. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2007 Ramesh R & Kumar K.U , "Renewable Energy Technologies", Narosa Publishing House, 2004  
J.G.McGowan, Manwell, J.F. and A.L.Rogers. Wind Energy Explained – Theory Design and Application, John Wiley and Sons Ltd, 2004.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : SOLAR AND WIND ENERGY TECHNOLOGY											Course Code : 20AE6A6				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the physics of solar radiation										1	K2	1,2,7,9	-	
CO 2	Classify the solar energy collectors and methodologies of storing solar energy										2	K2	1,2,7,10	-	
CO 3	Compute the torque and power characteristics of wind										3	K3	1,2,7,9	-	
CO 4	Classify the Wind mill types										4	K2	1,2,7,10	-	
CO 5	Describe the method of power generation from Wind mills										5	K2	1,2,7,9	-	
CO 6	Describe the various alternative energy sources										5	K3	1,2,7,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	2	-	2	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	2	-	-	1	-	-	-	-	-
CO 3	3	3	-	-	-	-	2	-	2	-	-	-	-	-	-
CO 4	2	1	-	-	-	-	2	-	-	1	-	-	-	-	-
CO 5	2	1	-	-	-	-	2	-	2	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	2	-	-	1	-	-	-	-	-

**PROFESSIONAL ELECTIVE – II  
(VII SEMESTER)**

<b>20AE7A1</b>	<b>AUTOMOTIVE HEATING VENTILATION AND AIR- CONDITIONING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the automotive air conditioning fundamentals.
- To understand the air conditioning heating system.
- To explain refrigerants handling system.
- To explain the air conditioner maintenance and service in vehicles

**PRE-REQUISITE:**

Course Code: 20AE301

Course Name: Applied Thermodynamics

**UNIT-I                      AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS                      9**

Basic air conditioning system , location of air conditioning components in a car, schematic layout of a refrigeration system, compressor components, condenser and high pressure service ports, thermostatic expansion valve, expansion valve calibration, controlling evaporator temperature, evaporator pressure regulator, evaporator temperature regulator

**UNIT-II                      AIR CONDITIONER – HEATING SYSTEM                      9**

Automotive heaters, manually controlled air conditioner, heater system, automatically controlled air conditioner and heater systems, automatic temperature control, air conditioning protection, engine protection.

**UNIT - III                      REFRIGERANT                      9**

Containers handling refrigerants, tapping into the refrigerant container, refrigeration system diagnosis, diagnostic procedure, ambient conditions affecting system pressures.

**UNIT - IV                      AIR ROUTING AND TEMPERATURE CONTROL                      9**

Objectives, evaporator airflow through the recirculating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control and handling systems.

**UNIT - V                      AIR CONDITIONER AND HEATER SERVICE                      9**

Air conditioner maintenance and service, servicing heater system removing and replacing components, trouble shooting of air controlling system, compressor service.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Warren Farnell and James D.Halderman, "Auto Heating, Ventilation, and Air Conditioning systems", Pearson Prentice Hall, 4<sup>th</sup> edition 2015
2. Warren Farnell and James D.Halderman, "Automotive Heating, Ventilation, and Air Conditioning systems", Classroom Manual& shop manual , Pearson Prentice Hall, 2004
- 3.Boyce H.DWiggins- "Automotive Air Conditioning" - Delmar – 2002
4. William H Crouse and Donald L Anglin, "Automotive Air conditioning", McGraw Hill Inc., 1990.

**REFERENCES:**

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

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: Automotive Heating Ventilation and Air-conditioning											Course Code : 20AE7A1				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the fundamentals of automotive air										1	K2	1,2,3,9	-	
CO 2	Understand the air conditioner and heating system										2	K2	1,2,3,10	-	
CO 3	Describe the refrigerants handling in air										3	K2	1,2,3,10	-	
CO 4	Understand the control mechanism for air										4	K2	1,2,3,9	-	
CO 5	Explain the duct system for automotive air										4	K2	1,2,3,9	-	
CO 6	Describe the maintenance and service procedure of automotive air										5	K2	1,2,3,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	-	1	2	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-
CO 6	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-

<b>20AE7A2</b>	<b>OFF ROAD VEHICLES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- Understand the construction and various applications of off road vehicles.
- Explain the industrial and constructional equipments in off road vehicles.
- Explain the working of farm equipments, special vehicles and military vehicles.

**PRE-REQUISITE: NIL****UNIT-I EARTH MOVING EQUIPMENTS 9**

Construction layout, capacity and applications of off road vehicle - prime mover, chassis and transmission, dumpers - safety features, safe warning system for dumper , Design aspects on dumper body, Articulated Dumpers, loaders - single bucket, Multi bucket and rotary types – bulldozers, excavators, backhoe loaders, scrapers, motor graders, power shawl, bush cutters, Bush cutters, stumpers, rippers

**UNIT-II INDUSTRIAL APPLICATIONS 9**

Constructional and working details of Jib crane, compactors - vibratory compactors, forklift, utility vehicles, man - lift, scissors, lift trucks, material handlers, -case studies.

**UNIT - III CONSTRUCTIONAL EQUIPMENTS 9**

Layout of constructional equipment Excavators, cranes, Hoist motor graders mixing machines, concrete ready mixers, Drillers, Ramming machines for construction of bridges and working principles , power generators

**UNIT - IV FARM EQUIPMENTS, MILITARY VEHICLES AND SPECIAL UTILITY VEHICLES 9**

Tractors, classification - working attachments, hydraulic control system, power take off, special implements, special features and constructional details of military tankers, gun carriers and transport vehicles. Oil tankers –Articulated vehicles, working -features of Ambulance, fire extinguishing vehicle.

**UNIT - V VEHICLE SYSTEMS, FEATURES 9**

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders, Power steering system, Kinematics for loader and bull dozer operational linkages .Safety features, Safe warning system for dumper. Design aspects on dumper body and water tank sprinkler.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Abrosimov.K. Bran berg.A and Katayer.K., "Road making machinery", MIR Publishers, Moscow, 1971.
2. Nakra C.P., "Farm machines and equipments" Dhanpatrai Publishing company Pvt. Ltd.
3. Robert L Peurifoy, "Construction, planning, equipment and methods" Tata McGraw Hill Publishing company Ltd.
4. SAE Handbook Vol. III., Society of Automotive Engineers, 1997
5. Wong.J.T., "Theory of Ground Vehicles", John Wiley & Sons, New York, 1987.

**REFERENCES:**

1. Bart H Vanderveen, "Tanks and Transport Vehicles", Frederic Warne and Co Ltd., London. S. Ageikin, "Off the Road Wheeled and Combined Traction Devices: Theory and Calculation", Ashgate Publishing Co. Ltd. 1988.
2. Schulz Erich.J, "Diesel equipment I & II", McGraw Hill company, London, 1982.
3. Satyanarayana. B., "Construction planning and equipment", standard publishers and distributors, New Delhi, 2010

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: OFF ROAD VEHICLES											Course Code : 20AE7A2				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the construction and layout of earth moving machines.										1	K3	1,2,3,4,	-	
CO 2	Infer the different types of subsystem and its functioning used in the construction of off road vehicle.										1	K3	1,2,3,4,	-	
CO 3	Understand the construction and working of industries equipments.										2	K3	1,2,3,4,	-	
CO 4	Classify and observe the application of special purpose vehicles in construction activities.										3	K3	1,2,3,4,	-	
CO 5	Illustrate the construction of farm equipments and understand the construction of military vehicles.										4	K3	1,2,3,4,	-	
CO 6	Identify the design requirements of off road vehicles										5	K2	1,2,3,4,	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 2	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 4	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 5	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 6	3	2	2	1	-	-	-	-	1	-	-	-	-	-	-

<b>20AE7A3</b>	<b>NOISE, VIBRATION AND HARNESS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To acquire knowledge on sources of noise, vibration and harshness
- To Understand the effect of noise on human comfort and environment
- To explain measurement techniques and control techniques of vibration and noise

**PRE-REQUISITE:**

Course Code: 20AE401

**Course Name: Mechanics of Machines****UNIT-I INTRODUCTION TO NOISE, VIBRATION AND HARSHNESS 9**

Definition of Noise, Vibrations & Harshness in reference to Vehicular application - Noise - Definition, basic attributes of sound and units (wavelength, period, frequency velocity, speed, pressure, power and sound intensity - sound wave -properties, sound sources, sound propagation in the atmosphere, sound radiation from Structures - General Introduction to Vibration, free and forced vibration, undamped and damped vibration, linear and non linear vibration.

**UNIT-II EFFECTS OF NOISE AND VIBRATION ON PEOPLE 9**

Effects on people and hearing conservation, sleep disturbance due to transportation noise exposure, noise-induced annoyance, effects of infrasound, low-frequency noise and ultrasound on people, auditory hazards of impulse and impact noise, effects of intense noise on people and hearing loss, effects of vibration on people, rating measures, and procedures for determining human response to noise and vibration.

**UNIT - III TRANSPORTATION NOISE AND VIBRATION – SOURCES, PREDICTION AND CONTROL 9**

Internal Combustion Engine Noise - Prediction and Control, Diesel exhaust and intake noise and acoustica Tire/Road Noise - Generation, Measurement, and Abatement - Aerodynamic Sound Sources in Vehicle Control, Transmission, Gearbox Noise, Vibration, prediction and control, Brake Noise Prediction and Control

**UNIT - IV TRANSDUCERS AND MEASUREMENT TECHNIQUES 9**

Transducers and exciters - Sound pressure, intensity and power measurement. Sound level meters, noise dosimeters, analyzers and signal generators, equipment for data acquisition and digital signal processing - Calibration of measurement microphones, calibration of shock and vibration transducers, metrology and traceability of vibration and shock measurements..

**UNIT - V NOISE AND VIBRATION IN INTERIOR TRANSPORTATION AND SAFETY 9**

Interior Transportation Noise and Vibration - Introduction - Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors-Prediction and Control - Study of NVH - Legislations applicable for vehicles in India-Safety - Passive safety Active safety. Study of Safety Regulations for vehicular application.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Clarence W. de Silva , “Vibration Monitoring, Testing, and Instrumentation “,CRC Press, 2007
2. David A.Bies and Colin H.Hansen “Engineering Noise Control: Theory and Practice “Spon Press, London, 2009
3. Xu Wang, Vehicle Noise and Vibration Refinement, Sawston, Cambridge: Woodhead PublishingLtd, 2010.

**REFERENCES:**

1. Allan G. Piersol ,Thomas L. Paez “Harris’ Shock and Vibration Handbook”, McGraw-Hill , New Delhi, 2010
2. Colin H Hansen “Understanding Active Noise Cancellation“ , Spon Press , London 2003
3. Matthew Harrison “Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles “ , Elsevier Butterworth-Heinemann, Burlington, 2004

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : NOISE, VIBRATION AND HARNES		Course Code : 20AE7A3			
CO	Course Outcomes	Unit	K-CO	POs	PSOs
CO1	Explain the basic concept of vibration, sources of vibration and noises in automobiles.	1	K2	1,2,3,9	-
CO 2	Describe the effect of noise and vibration on human beings and nature.	2	K2	1,2,3,10	-
CO 3	Explain the various methods to predict and control the noise and vibration in different components of automobiles.	3	K2	1,2,3,10	-
CO 4	Determine the suitable transducers to reduce the noise and vibration in automobiles.	4	K2	1,2,3,9	-
CO 5	Explain the different NVH controlling techniques in an interior transportation and safety precautions	5	K2	1,2,3,9	-
CO6	Apply the engineering techniques, tools, for measurement methods in order to learn to control and solve complex Vehicle vibrations behaviour /as well as performance problems.	5	K2	1,2,3,9	-

**CO – PO MAPPING**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	-	1	2	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-
CO 6	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-

<b>20AE7A4</b>	<b>ENGINE AND VEHICLE MANAGEMENT SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the fundamental of automotive electronics
- To understand the functions of the various types of sensors
- To explain control and working of SI engine management system
- To describe the function of various module of CI engine management system.
- To explain various types of vehicle management system

**PRE-REQUISITE:**

**Course Code: 20AE302, 20AE501**

**Course Name: Automotive Engines, Automotive Electrical and Electronics**

**UNIT-I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9**

Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines and in the other parts of the automobile.

**UNIT-II SENSORS 9**

Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors, gyro sensors.

**UNIT - III SI ENGINE MANAGEMENT 9**

Three way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Working of the fuel system components. Cold start and warm up phases idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel contro maps, open loop control of fuel injection and closed loop lambda control. Electronic ignition systems and spark timing control. Closed loop control of knock.

**UNIT - IV CI ENGINE MANAGEMENT 9**

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valves

**UNIT - V VEHICLE MANAGEMENT SYSTEMS 9**

ABS system, its need, layout and working. Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System of air bag system – crash sensor, seat belt tightening. Cruise control. Vehicle security systems- alarms, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Eric Chowanietz "Automobile Electronics" SAE Publications, 1994
2. William B Ribbens "Understanding Automotive Electronics", SAE Publications, 1998

**REFERENCES:**

1. Robert Bosch "Diesel Engine Management" SAE Publications, 2006.
2. Robert Bosch, "Gasoline Engine Management" SAE Publications, 2006.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: <b>ENGINE AND VEHICLE MANAGEMENT SYSTEMS</b>											Course Code : 20AE7A4				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the fundamental of automotive electronics										1	K2	1,2,3,4,9	-	
CO 2	Describe the functions of the various types of sensors										2	K2	1,2,3,4,10	-	
CO 3	Illustrate the control and working of SI engine management system										3	K2	1,2,3,4,9	-	
CO 4	Describe the function of various module of CI engine management system										4	K2	1,2,3,4,9	-	
CO 5	Explain the various types of control system in Vehicles										5	K2	1,2,3,4,10	-	
CO 6	Describe the functions of various safety devices										5	K2	1,2,3,4,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 2	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 4	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 5	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 6	3	2	2	1	-	-	-	-	1	-	-	-	-	-	-

<b>20AE7A5</b>	<b>VEHICLE MAINTENANCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the maintenance of records and schedules.
- To understand the engine and engine sub system maintenance.
- To explain the transmission and driveline maintenance.
- To describe the maintenance of steering, brake ,suspension and wheel.
- To explain maintenance of electrical components in a vehicle.

**PRE-REQUISITE:**

**Course Code:** 20AE302, 20AE402

**Course Name:** Automotive Engine, Automotive Chassis and Transmission

**UNIT-I MAINTENANCE OF RECORDS AND SCHEDULES 9**  
 Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance. service schedule (Manufacture Km service ) and service history maintenance. Automobile garages, type of layout and special tools used.

**UNIT-II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE 9**  
 General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls

**UNIT - III TRANSMISSION AND DRIVELINE MAINTENANCE 9**  
 Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

**UNIT - IV STEERING, BRAKE, SUSPENSION, WHEEL MAINTENANCE 9**  
 Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Inspection, Steering systems, overhauling and maintenance., Wheel alignment

**UNIT - V ELECTRICAL SYSTEM MAINTENANCE SERVICING ANDREPAIRS 9**  
 Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instrument- Diagnose troubles and Remedies.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Ed May, "Automotive Mechanics Volume One" and Two ,McGraw Hill Publications, eighth edition, 2009
2. Vehicle Service Manuals of reputed manufacturers

**REFERENCES:**

1. Bosch Automotive Handbook, Tenth Edition, 2018

**OUTCOMES:****AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>VEHICLE MAINTENANCE</b>											Course Code : <b>20AE7A5</b>				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO1	Explain the various forms and records of vehicle maintenance documents.										1	K2	1,2,3,9	-	
CO 2	Describe the maintenance and servicing of cooling system and lubrication system.										2	K2	1,2,3,10	-	
CO 3	Explain the maintenance and servicing clutch and transmission.										3	K2	1,2,3,10	-	
CO 4	Describe the maintenance and servicing of steering, brake, suspension and wheel.										4	K2	1,2,3,9	-	
CO 5	Explain the maintenance and servicing of electrical.										5	K2	1,2,3,9	-	
CO 6	Describe the fault diagnoses in the electrical components										5	K2	1,2,3,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	-	1	2	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-
CO 6	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-

<b>20AE7A6</b>	<b>ALTERNATIVE FUELS AND ENERGY SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To know about the types of alternative fuels and energy sources for IC engines
- To study the properties of vegetable oils.
- To understand the production methods of alcohols and their properties.
- To study the production methods of gaseous fuels like Biogas, NG, CNG and LPG.

**PRE-REQUISITE:**

Course Code: 20AE504

Course Name: Automotive Fuels and Lubricants

**UNIT-I Introduction 9**  
 Energy scenario in India - Energy and Environment Overview - Importance of Alternate Energy sources - Availability of Alternate Energy Sources for SI and CI Engines - Emission standards and measuring techniques.

**UNIT-II Vegetable Oil as fuels 9**  
 Availability of vegetable oils - Non-edible oils as biodiesel - Blending, Emulsification, Preheating and transesterification - Effect of vegetable oils physical and chemical characteristics on biodiesel properties - Estimation of Physical and chemical properties - Performance, Emission and Combustion Characteristics in diesel engines.

**UNIT - III Alcohols as Fuels 9**  
 Production methods of alcohols - Production of alcohol from biomass - Properties of alcohols as fuels - Methods of using alcohols in CI and SI engines - Blending, dual fuel operation, fumigation, surface ignition and oxygenated additives - Performance, emission and combustion characteristics in CI and SI engines.

**UNIT - IV Gaseous Fuels 9**  
 Production methods of Biogas, NG, CNG and LPG - Biogas Digester – Reactions -Viability - Economics - Physical and chemical properties - Modification required in SI and CI Engines - Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines

**UNIT - V Hybrid Electrical Vehicle 9**  
 Introduction to HEV -Types of motors, battery pack, and accessories - HEV Classification - Layout of series, parallel and combined HEV - Degree of Hybridization(strong, medium, mild/micro, Plug- in - Fuel cell Hybrid, Hydraulic Hybrid, Pneumatic Hybrid - Advantages and Disadvantages of HEV.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. AyhanDemirbas, —Biodiesel A Realistic Fuel Alternative for Diesel Enginesll, Springer-Verlag London Limited, 2016.
2. Richard Folkson, —Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performancell, Wood head Publishing Ltd., 2020.

**REFERENCES:**

1. S.S .Thipse, Alternate Fuels Concepts, Technologies and Dvelopments, Delhi : Jaico Publishing House, 2020.
2. V. Ganesan, Internal Combustion Engines, New Delhi : Tata Mcgraw Hill Publishing Co.Ltd 2016.
3. L .Mathur, R.P. Sharma, Internal Combustion Engines, New Delhi :Dhanpat Rai Publications (P),Ltd, 8th edition, 2017.
4. R. L. Bechfold, Alternative Fuels Guide Book, Warrendale : SAE International,2010.
5. Alcohols as motor fuels progress in technology, Series No.19,USA: SAE Publication, 1990

**OUTCOMES:****AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Alternative Fuels and Energy Systems										Course Code : 20AE7A6					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the emission standards and measuring techniques.										1	K2	1,2,3,4,9	-	
CO 2	Differentiate the conventional fuels and alternative fuels.										1	K2	1,2,3,4,10	-	
CO 3	Compare the properties of various vegetable oil and explain the performance Emission and combustion characteristics										2	K2	1,2,3,4,9	-	
CO 4	Describe the Performance, emission and combustion characteristics of alcohol used in CI and SI Engines.										3	K2	1,2,3,4,9	-	
CO 5	Explain the Performance and emission characteristics of biogas, NG and LPG in SI and CI engines.										4	K2	1,2,3,4,10	-	
CO 6	Explain the Working principle of hybrid and fuel cell powered Vehicle.										5	K2	1,2,3,4,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 2	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 4	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 5	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 6	3	2	2	1	-	-	-	-	1	-	-	-	-	-	-

KLNCE UG AUE R2020  
**PROFESSIONAL ELECTIVE – III**  
**(VII SEMESTER)**

<b>20AE7B1</b>	<b>LEAN METHODS FOR AUTOMOBILE ENGINEERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To study the basic concepts and importance of lean manufacturing (LM)
- To study about the various tools of lean manufacturing
- To understand the implementation of Lean methods in Industries

**PRE-REQUISITE: NIL**

**UNIT-I INTRODUCTION 9**  
 History –Basic concepts of TQM- TPS - Objectives - Implications of lean. Traditional Manufacturing vs lean manufacturing, Benefits of Lean –Importance of Lean methods in Automobile Industries.

**UNIT-II LEAN CONCEPTS 9**  
 Eight Types of waste -Value creation - Takt time – Takt time calculation. Continuous flow - Continuous improvement / Kaizen. Lean Culture - worker involvement. Lean administration / service, Lean product development- Group Technology.

**UNIT - III LEAN METHODS 9**  
 Value Stream Mapping: detailed process map - Machine cell design -Elimination of waste - 5S principles  
 One piece flow - Pull vs Push - JIT - Kanban. Role of Information technology in Lean methods – Industry 4.0

**UNIT - IV LEAN TOOLS 9**  
 Standard work - Spaghetti diagram – Process Map. Visual controls - Marquee - Andon - Vision system - Score board. TPM - OEE - Changeover/setup time (SMED) - Batch size reduction -Line balancing - Failure mode and effect analysis (FMEA) - Poka-yoke/ Error mistake proofing

**UNIT - V LEAN IMPLEMENTATION 9**  
 Road map to implementation of lean project -Lean six sigma- Best practices and Case studies in Automobile Industries.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Jeffrey Liker and Gary L. Convis, "The Toyota Way to Lean Leadership: Achieving and Sustaining Excellence through Leadership Development", McGraw Hills, 2012.
2. Taiichi Ohno and Norman Bodek, "Toyota Production System: Beyond Large-Scale Production", 1988. ISBN-13: 978-0915299140
3. Askin R G and Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003.

**REFERENCES:**

1. Michael L George, David T Rowlands, Bill Kastle, "What is Lean Six Sigma", McGraw Hill, New York, 2004.
2. Micheal Wader, "Lean Tools: A Pocket Guide to Implementing Lean Practices", Productivity and Quality Publishing Pvt Ltd, 2002.
3. Kenichi Sekine, "One-Piece Flow", Productivity Press, Portland, Oregon, 1992.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: LEAN METHODS FOR AUTOMOBILE ENGINEERS											Course Code : 20AE7B1				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Understand the principles of TQM, TPS and its importance in Automobile Industries										1	K2	1,2,7,8	-	
CO 2	Understand about the different types of waste and lean culture in organization.										2	K2	1,2,7,8	-	
CO 3	Understand the concepts VSM,JIT and Kanban										3	K2	1,2,7,8,9	-	
CO 4	Understand and Apply the concepts TPM, SMED										4	K2	1,2,7,8	-	
CO 5	Understand and apply the concepts of FMEA and Poka Yoke.										4	K2	1,2,7,8,9	-	
CO 6	Understand the implementation of lean tools in Industries.										5	K2	1,2,7,8	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	1	1	1	-	-	-	-	-	-
CO 4	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-
CO 5	2	1	-	-	-	-	1	1	1	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-

<b>20HS6A1</b>	<b>INTELLECTUAL PROPERTY RIGHTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To get an adequate knowledge on patent and copyright for their innovative research works.
- To use in their career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search. This provides further way for developing their idea or innovations.
- To pave the way to catch up Intellectual Property (IP) as a career option.
  - R & D IP Counsel
  - Government Jobs – Patent Examiner
  - Private Jobs
  - Patent agent and Trademark agent
  - Entrepreneur.

**PRE-REQUISITE: NIL****UNIT-I OVERVIEW OF INTELLECTUAL PROPERTY 9**

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design - Genetic Resources and Traditional Knowledge - Trade Secret - IPR in India: Genesis and development - IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention - 1883, the Berne Convention - 1886, the Universal Copyright Convention - 1952, the WIPO Convention - 1967, the Patent Co-operation Treaty - 1970, the TRIPS Agreement - 1994.

**UNIT-II PATENTS 9**

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non-Patentable Subject Matter - Registration Procedure - Rights and Duties of Patentee - Assignment and license - Restoration of lapsed Patents - Surrender and Revocation of Patents - Infringement - Remedies & Penalties - Patent office and Appellate Board.

**UNIT - III COPYRIGHTS 9**

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works - cinematograph films and sound recordings - Registration Procedure - Term of protection - Ownership of copyright - Assignment and license of copyright - Infringement - Remedies & Penalties - Related Rights - Distinction between related rights and copyrights.

**UNIT - IV TRADEMARKS 9**

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board.

**UNIT - V OTHER FORMS OF IP & REGISTRATION PROCESS 9**

Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection. Geographical Indication (GI): meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection. IPR registration process through government website-modalities and publications. Plant Variety Protection: meaning and benefit sharing and farmers' rights – Procedure for registration, effect of registration and term of protection. Layout Design Protection: meaning – Procedure for registration, effect of registration and term of protection.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. K.V.Nithyananda, “Intellectual Property Rights: Protection and Management”, Cengage Learning India Pvt. Ltd., 2019.
2. P.Neeraj and D.Khusdeep, “Intellectual Property Rights”, PHI Learning Pvt. Ltd., 2014.

**REFERENCES:**

1. V.K.Ahuja, “Law Relating to Intellectual Property Rights”, Lexis Nexis, Third Edition, 2017.
2. Journal of Intellectual Property Rights (JIPR): NISCAIR
3. Cell for IPR Promotion and Management (<http://cipam.gov.in/>)
4. World Intellectual Property Organization (<https://www.wipo.int/about-ip/en/>)
5. Office of the Controller General of Patents, Designs & Trademarks (<http://www.ipindia.nic.in/>)

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: INTELLECTUAL PROPERTY RIGHTS												Course Code : 20HS6A1				
CO	Course Outcomes											Unit	K-CO	Pos	PSOs	
CO 1	Explain the fundamental aspects of Intellectual property Rights which plays a major role in development and management of innovative projects in industries.											1	K2	1,2,8	-	
CO 2	Describe the patents, patent regime in India and abroad and registration aspects.											2	K2	1,2,8	-	
CO 3	Describe the copyrights and its related rights and registration aspects.											3	K2	1,2,8	-	
CO 4	Explain the trademarks and registration aspects.											4	K2	1,2,8	-	
CO 5	Explain the Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects.											5	K2	1,2,8	-	
CO 6	Analyze the current trends in IPR and Government steps in fostering IPR											5	K3	1,2,8	-	
CO – PO MAPPING																
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO 1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	
CO 2	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	
CO 3	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	
CO 4	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	
CO 5	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	
CO 6	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	

<b>20HS7A2</b>	<b>TOTAL QUALITY MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand TQM concepts.
- To know about TQM principles.
- To understand Six Sigma, Traditional tools, New tools, Benchmarking and FMEA.
- To understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
- To apply QMS and EMS in any organization.

**PRE-REQUISITE: NIL****UNIT-I INTRODUCTION 9**

Quality – Need, Evolution, Definitions, Dimensions of product and service quality. TQM – Basic concepts, Framework, Contributions of Deming, Juran and Crosby, Barriers. Quality statements, Customer satisfaction, Customer complaints, Customer retention, Costs of quality.

**UNIT-II TQM PRINCIPLES 9**

Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Teamwork, Quality circles, Recognition and Reward, Performance appraisal, Continuous process improvement - PDCA cycle, 5S, Kaizen, Supplier partnership, Supplier selection, Supplier Rating.

**UNIT - III TQM TOOLS AND TECHNIQUES I 9**

Traditional tools of quality, New management tools. Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA - Stages, Types.

**UNIT - IV TQM TOOLS AND TECHNIQUES II 9**

Control Charts, Process Capability, Quality Function Development (QFD), Taguchi quality loss function, TPM - Concepts, improvement needs, Performance measures.

**UNIT - V QUALITY SYSTEMS 9**

Need for ISO 9000, ISO 9001-2008 Quality System, Elements, Documentation, Quality Auditing, QS 9000 - ISO 14000, Concepts, Requirements and Benefits, TQM Implementation in manufacturing and service sectors.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Dale H. Besterfield, et al., "Total quality Management", Pearson Education Asia, 5<sup>th</sup> Edition, 2018.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", Cengage Learning, 8th Edition, 2012.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2<sup>nd</sup> Edition, 2006.

**REFERENCES:**

1. Joel.E. Ross, "Total Quality Management – Text and Cases", CRC Press, 5<sup>th</sup> Edition, 2017.
2. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 1<sup>st</sup> Edition, 2016.
3. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3<sup>rd</sup> Edition, 2012.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 1<sup>st</sup> Edition, 2006.
5. Brue G, "Six Sigma for Managers", Tata-McGraw Hill, 2<sup>nd</sup> Edition, 2002.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : TOTAL QUALITY MANAGEMENT							Course Code : 20HS7A2							
CO	Course Outcomes						Unit No	K –CO	POs	PSOs				
C409B5.1	Explain basic concepts, TQM framework, Barriers Benefits of TQM and importance of customers						I	2	6,8 -12	-				
C409B5.2	Explain the TQM Principles, understand the importance of employee involvement and supplier partnership						II	2	6,8 -12	-				
C409B5.3	Explain the basics of Six Sigma, Traditional tools, New tools,						III	K2	6,8 -12	-				
C409B5.4	Explain the process of Benchmarking and FMEA.						IV	K2	6,8 -12	-				
C409B5.5	Explain process capability, QFD, TPM, Taguchi quality loss function and performance measures						V	K2	6,8 -12	-				
C409B5.6	Explain the Quality system ISO 9000, ISO 14000, Audit, Certification process and implementation of TQM in manufacturing and service sectors						V	K2	6,7,8-12	-				
CO-PO Mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C409B5.1	1				1	2		2	2	2	2	1		
C409B5.2	1				2	2		2	2	2	2	1		
C409B5.3	1				2	2		2	2	2	2	1		
C409B5.4	1				2	2		2	2	2	2	1		
C409B5.5	1				2	2		2	2	2	2	1		
C409B5.6	1				-	2	2	2	2	2	2	1		



**TEXT BOOKS:**

1. Hamdy A.Taha "Operations Research – An Introduction", MacMillan India Ltd., 10<sup>th</sup> Edition, 2017.
2. Panneer selvam R, "Operations Research", Prentice Hall India, 2016.
3. Hira.D Gupta.P.K, "Operations Research", S. Chand Publications, 1<sup>st</sup> Edition, Reprint 2016

**REFERENCES:**

1. G.Srinivasan, "Operations Research: Principles and Applications", PHI Ltd., 2016.
2. Kantiswarup Gupta.P.K, Man Muhan "Operations Research: Sultan Chand & Sons India Ltd., 12<sup>th</sup> Edition, New Delhi 2016.
3. Philips, Ravindran and Solberg, "Operations Research principle and practise", John Wiley, 2016.
4. Hiller and Liberman, Introduction to Operations Research, McGraw Hill, 2015.  
Ramamurthy P, "Operations Research", New age International Publishers, 2<sup>nd</sup> edition, 2007.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : OPERATIONS RESEARCH											Course Code : 20HS601				
CO	Course Outcomes										Unit	K-CO	POs		
CO 1	Solve Linear Programming Problems by appropriate technique.										1	K3	1,2,3,8,10		
CO 2	Determine the performance characteristics such as time and cost in solving shortest route, transportation problems with an appropriate model.										2	K3	1,2,3,9,10		
CO 3	Solve the given assignment problem with an appropriate method.										2	K3	1,2,3,8,10		
CO 4	Determine the optimal solution for a project scheduling problem.										3	K3	1,2,3		
CO 5	Determine the order quantity of goods under different constraints.										4	K3	1,2,3,8		
CO 6	Determine the solutions to single and multi channel Queuing problems.										5	K3	1,2,3,8,9,10		
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	-	-	2	-	2	-	-	-	-	-
CO 2	3	2	1	-	-	-	-	-	2	2	-	-	-	-	-
CO 3	3	2	1	-	-	-	-	2	-	2	-	-	-	-	-
CO 4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	1	-	-	-	-	2	-	-	-	-	-	-	-
CO 6	3	2	1	-	-	-	-	1	2	2	-	-	-	-	-

<b>20HS6A2</b>	<b>ENTREPRENEURSHIP DEVELOPMENT</b>	KLNCE UG AUE R2020			
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To develop and strengthen entrepreneurial quality in students.
- To gain knowledge on Entrepreneurial Environment for nurturing the new startups
- To impart basic entrepreneurial skills like Ideation, Product development, and Project Management
- To bring the concept of Financing and Management of small enterprise.
- To implement concept of Technopreneurship more efficiently and effectively.

**PRE-REQUISITE: NIL**

**UNIT-I INTRODUCTION 9**  
 Definition & structure of Entrepreneurship - Entrepreneurial Culture- Origin of Entrepreneurship - Characteristics of an Entrepreneur - Qualities and Skills of Entrepreneur – Types of Entrepreneurs – Women Entrepreneurs

**UNIT-II ENTREPRENEURIAL ECOSYSTEM 9**  
 Entrepreneurial Environment - Role of Family and Society -Entrepreneurship Development Program(EDP)- EDP Training-Institutions in support of Entrepreneurship(SIPCOT,EDC,ITCOT) - Central and State Government Industrial Policies and Regulations-Incubation.

**UNIT - III PROJECT MANAGEMENT 9**  
 Ideation/Innovation – Product Planning and Development Process-Projects and its classification-Project life Cycle-Phases of Project Management-Project Identification and Selection- Project Formulation - Project Appraisal.

**UNIT - IV LAUNCHING AND MANAGING OF SMALL ENTERPRISE 9**  
 Ownership Structure - Financial Planning, Human resource mobilization-Operations planning-Market and channel selection. Venture capital – IT startups and its case studies

**UNIT - V TECHNOPRENEURSHIP 9**  
 E-Commerce – Application – Benefits – Limitation – Opportunities-Resources Required-Operation & Problems, Security & Safety of Business Transaction, Encryption, Digital Signature, Cybercrime, Mode of Payment -EFT, E-check, E-Money, Credit Cards, Debit Cards, Smart Cards, M-Commerce, Application of M-Commerce

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Vasant Desai, “Dynamics of Entrepreneurial Development and Management”, Himalaya Publishing House, Sixth Edition, 2019.
2. S.S.Khanka, “Entrepreneurial Development”, S.Chand and Company Limited, New Delhi,(Revised Edition) 2013.
3. Dr.R.C.Bhatia, “Entrepreneurship Business and Management”, Sultan Chand & Sons.EducationalPublishers,New Delhi, 2020.

**REFERENCES:**

1. Drucker, Peter. “Innovation and Entrepreneurship”. United Kingdom, Routledge, 2015.
2. Hisrich, “Entrepreneurship”, Edition 9, Tata McGraw Hill, New Delhi, 2014.
3. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis,Biztrantra, 2nd Edition ,2005.
4. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996
5. Donal F Kuratko, T.V.Rao, Entrepreneurship: A South Asian Perspective, Cengage, 2012

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: ENTREPRENEURSHIP DEVELOPMENT										Course Code : 20HS6A2					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the qualities of an Entrepreneur and his Role in startup.										1	K2	8,9	-	
CO 2	Illustrate the Entrepreneurial Environment for bringing more ventures										2	K2	8,9	-	
CO 3	Determine the ideation, Product Development, and Project Management										3	K2	8,9,10,11	-	
CO 4	Illustrate Finance planning and capital venture										4	K2	8,9	-	
CO 5	Explain the use of ownership in the small business.										5	K2	8,9,10	-	
CO 6	Explain the E- Commerce and M-Commerce for the Technopreneurship Development										5	K2	8,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	2	2	1	1	-	-	-	-
CO 4	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	2	2	1	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-

<b>20HS602</b>	<b>PRINCIPLES OF MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- Study the evolution of Management And organization types
- Learn the concepts involved in Planning process
- Explain how organizing is done by manager
- Detail on Human Resource Management and , Career planning
- Learn the importance of Motivation and leadership
- Detail on directing and controlling in Management

**PRE-REQUISITE: NIL**

**UNIT-I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9**

Definition of Management – Science or Art – Managerial roles and skills – Theories of Management- F.W.Taylor, Elton Mayo - Principles of Henry Fayol – Types of Business organization – Sole proprietorship, partnership, company- Types -public and private sector enterprises – Current trends and issues in Management.

**UNIT-II PLANNING 9**

Nature and purpose of planning – process – types – objectives – MBO- Policies – Planning premises- Tools and Techniques ; Strategic planning - Types – Decision making steps and process. Rational Decision Making Process - Decision Making under different conditions.

**UNIT - III ORGANISING AND STAFFING 9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Man Power planning- Recruitment & selection process, Training and Development, Performance Management , Career planning and management. Career Development - Career stages – Training - Performance Appraisal.

**UNIT - IV DIRECTING 9**

Foundations of individual and group behavior – motivation – motivation theories – Motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and role of information technology.

**UNIT - V CONTROLLING 9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – Cost Control - Purchase Control - Maintenance Control - Quality Control

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Stephen P. Robbins & Mary Coulter, —Managementll, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2020.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert —Managementll, Pearson Education, 6th Edition, 2018.

**REFERENCES:**

1. Stephen A. Robbins & David A. Decenzo& Mary Coulter, —Fundamentals of Managementll Pearson Education, 7th Edition, 2019.
2. Robert Kreitner&MamataMohapatra, — Managementll, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich —Essentials of managementll Tata McGraw Hill,2018.
4. Tripathy PC & Reddy PN, —Principles of Managementll, Tata McGraw Hill, 2016

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : PRINCIPLES OF MANAGEMENT											Course Code : 20HS602				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the evolution of Management and organization types										1	K2	8,9,10,11	-	
CO 2	Demonstrate the concepts involved in Planning process										2	K2	8,9,10,11,12	-	
CO 3	Describe the organizing concept and its types.										3	K2	8,9,10,11	-	
CO 4	Explain the human resource management and, career planning process.										3	K2	8,9,10,11	-	
CO 5	Illustrate the importance of Motivation and leadership.										4	K2	8,9,10,11,12	-	
CO 6	Explain the directing and controlling in Management process.										5	K2	8,9,10,11	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	-	-	2	2	2	1	-	-	-	-
CO 2	-	-	-	-	-	-	-	2	2	2	1	1	-	-	-
CO 3	-	-	-	-	-	-	-	2	2	2	1	-	-	-	-
CO 4	-	-	-	-	-	-	-	2	2	2	1	-	-	-	-
CO 5	-	-	-	-	-	-	-	2	2	2	1	1	-	-	-
CO 6	-	-	-	-	-	-	-	2	2	2	1	-	-	-	-

**PROFESSIONAL ELECTIVE – IV  
(VIII SEMESTER)**

<b>20AE8A1</b>	<b>TRANSPORT MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the personnel management for transport
- To understand the passenger transport operation and fare collection system
- To explain the insurance policies and maintenance procedure

**PRE-REQUISITE: NIL**

**UNIT-I INTRODUCTION 9**

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

**UNIT-II TRANSPORT SYSTEMS 9**

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

**UNIT - III PASSENGER TRANSPORT OPERATION, SCHEDULING AND FARE STRUCTURE 9**

Principal features of operating costs for transport vehicles with examples of estimating the costs, Fare structure and method of drawing up of a fare table, Various types of fare collecting methods, Basic factors of bus scheduling, Problems on bus scheduling.

**UNIT - IV INSURANCE AND MOTOR VEHICLE ACT 9**

Laws governing to use of motor vehicle & motor transport, Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive. Insurance, various types, Comprehensive, Third party insurance, MACT (Motor Accident claim Tribunal), Hit & run case, Duty of driver in case of accident. Surveyors report.

**UNIT - V MAINTENANCE 9**

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2. Kitchin.L.D., "Bus Operation", III edition, Illiffie and Sons Co., London, 1992

**REFERENCES:**

1. Transport development in india S.Chand & Co Pvt Ltd. Newdelhi.
2. Government Motor Vehicle Act, Publication on latest act to be used as on date

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>TRANSPORT MANAGEMENT</b>											Course Code : <b>20AE8A1</b>				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the various management functions in transport systems.										1	K2	1,2,3,9	-	
CO 2	Acquire the knowledge about the operations of transport systems.										2	K2	1,2,3,10	-	
CO 3	Understand the scheduling and fare structure in transport systems.										3	K2	1,2,3,10	-	
CO 4	Understand the laws of motor vehicle act in transport systems.										4	K2	12,3,10	-	
CO 5	Familiar with various types of vehicle insurance in motor vehicles.										4	K2	1,2,3,10	-	
CO 6	Understand the various maintenance procedures in transport systems.										5	K3	1,2,3,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 6	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-

<b>20AE8A2</b>	<b>AUTOMOTIVE SAFETY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand automotive safety in the broader context of transportation safety.
- To explain the different types of vehicle safety systems used in automobiles.
- To provide knowledge on the different comfort and convenience system used in automobiles.

**PRE-REQUISITE:****Course Code: 20AE501****Course Name: Automotive Electrical and Electronics**

**UNIT-I INTRODUCTION 9**  
Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumple zone, safety sandwich construction

**UNIT-II SAFETY CONCEPTS 9**  
Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

**UNIT - III SAFETY EQUIPMENTS 9**  
Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

**UNIT - IV COLLISION WARNING AND AVOIDANCE 9**  
Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

**UNIT - V COMFORT AND CONVENIENCE SYSTEM 9**  
Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Bosch, "Automotive Handbook", 10<sup>th</sup> Edition, SAE publication, 2018.
2. George. A.Peters, Barbara. J.Peters, Automotive Vehicle Safety, CRC Press, First Edition, 2002.
3. Robert Bosch GmbH - "Safety, Comfort and Convenience Systems"- Wiley; 3rd edition, 2007

**REFERENCES:**

1. Mark Gonter and Ulrich Seiffert, —Integrated Automotive Safety HandbookII, SAE Publication, 2013.
2. J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori - "Sensors for Automotive Applications"— WILEYVCH Verlag GmbH & Co. 2003
3. Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., -1999.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>AUTOMOTIVE SAFETY</b>										Course Code : <b>20AE8A2</b>					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Describe the concepts of safety measures in automobiles.										1	K2	1,2,3,9	-	
CO 2	Explain the concept of crumble zone.										1	K2	1,2,3,9	-	
CO 3	Describe the different types of active and passive safety system used in automobiles.										2	K2	1,2,3,4,10	-	
CO 4	Explain the working of passive safety components such as air bags, seatbelts.										3	K2	1,2,3,4,10	-	
CO 5	Explain the collision warning and avoidance systems in automobiles.										4	K2	1,2,3,10	-	
CO 6	Describe the different comfort and convenience system used in automobiles.										5	K2	1,2,3,4,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	1	-	-	-	-	-	-
CO 3	3	3	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	3	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 6	3	3	2	1	-	-	-	-	-	2	-	-	-	-	-

<b>20AE8A3</b>	<b>AUTOMOTIVE POLLUTION CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To study about the role and drivers of and supply chain management.
- To explain about Supply Chain Network Design.
- To illustrate about the issues related to Logistics in Supply Chain.
- To appraise about Sourcing and Coordination in Supply Chain.
- To study about the application of Information Technology and Emerging Concepts in Supply.

**PRE-REQUISITE:**

Course Code: 20HS401

Course Name: Environmental Science and Engineering

**UNIT-I INTRODUCTION 9**

Pollutants – sources – formation – effects of pollution on environment - human – transient operational effects on pollution – Regulated – Unregulated emissions - Emission Standards- Euro, Bharat Stage & Legislative Norms.

**UNIT-II POLLUTANT FORMATION IN SI ENGINES 9**

Chemistry of SI engine combustion – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating variables on emission formation.

**UNIT - III POLLUTANT FORMATION IN CI ENGINES 9**

Basics of diesel combustion – Smoke emission and its types in diesel engines – NO<sub>x</sub> emission and its types from diesel engines – Particulate emission in diesel engines. Odor, sulfur and Aldehyde emissions from diesel engines – effect of operating variables on emission formation

**UNIT - IV CONTROL TECHNIQUES FOR REDUCTION OF EMISSION 9**

Design modifications – Optimization of operating factors – Fuel modification – Evaporative emission control - Exhaust gas recirculation – SCR – Fumigation – Secondary Air injection – PCV 157 system – Particulate Trap – CCS – Exhaust treatment in SI engines – Thermal reactors – Catalytic converters – Catalysts – Use of unleaded petrol.

**UNIT - V MEASUREMENT TECHNIQUES EMISSION STANDARDS AND TEST PROCEDURE 9**

Test procedures CVS1, CVS3 – Test cycles – IDC – ECE Test cycle – FTP Test cycle – NDIR analyzer – Flame ionization detectors – Chemiluminescent analyzer – Dilution tunnel – Gas chromatograph – Smoke meters –SHED test.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Pundir. B.P., “ IC Engines Combustion and Emissions” Narosa Publishers, 2010
2. Ganesan, V- “Internal Combustion Engines”- Tata McGraw-Hill Co4<sup>th</sup> edition 2012
3. Robert Bosch, “Emissions-Control Technology for Diesel Engines”, BENTLEY ROBERT Incorporated, 2005
4. Springer and Patterson, "Engine Emission", Plenum Press, 1990.

**REFERENCES:**

1. Ramalingam.K.K., "InternalCombustionEngines", ScitechPublications, ISBN8283716733, 9788183716734, 2018
2. Automobiles and Pollution SAE Transaction, 1995
3. Heywood, J.B., "Internal Combustion Engine Fundamentals", McGraw Hill Book Co., 1995.
4. Paul Degobert – Automobiles and Pollution – SAE International ISBN-156091-563-3, 1991.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : AUTOMOTIVE POLLUTION CONTROL											Course Code : 20AE8A3				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the norms of pollution standards.										1	K2	1,2,3,9	-	
CO 2	Describe the pollutant formation in SI engines.										2	K2	1,2,3,10	-	
CO 3	Explain the pollutant formation in CI engines.										3	K2	1,2,3,9	-	
CO 4	Discuss the pollution control methods from automobiles.										4	K2	1,2,3,10	-	
CO 5	Explain the operating variables on emission formation.										4	K2	1,2,3,9	-	
CO 6	Describe the test procedure for emission.										5	K2	1,2,3,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 2	3	2	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 3	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 4	3	2	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 5	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 6	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-

<b>20AE8A4</b>	<b>AUTOMOTIVE TESTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To introduce the learners with the need for automotive testing methods and their importance.
- To equip them with knowledge in crash testing standards.
- To understand in various testing of wheels and brakes.
- To equip them with knowledge in energy and fuel consumption testing and guidelines.
- To understand the vehicle component related testing.

**PRE-REQUISITE: NIL****UNIT-I VEHICLE WIND TUNNEL TESTING AND BODY TESTING 9**

Wind tunnel test requirements - Ground boundary simulation - wind tunnel selection and Reynolds number capability, model details, mounting of model, Test procedure. Body test - Dynamics simulation sled testing - Dolly roll over test - Dolly roll over fixture - vehicle roof strength test - Door system crash test

**UNIT-II COLLISION AND CRASH TESTING 9**

Crash testing: Human Testing, Dummies, Crash worthiness, pole crash testing, near crash testing, vehicle to vehicle impact, side impact testing, crash test sensor, sensor mounting positions, crash test data acquisition, braking distance test.

**UNIT - III TESTING OF WHEELS AND BRAKES 9**

Wheels: Dynamic cornering fatigue, dynamic radial fatigue tests-procedures, bending moment and radial load calculations. Impact test -Road hazard impact test for wheel and tyre assemblies test procedures, Failure criteria and performance criteria.

**UNIT - IV ENERGY AND FUEL CONSUMPTION TESTING 9**

Engine cooling fan, air conditioning and brake compressors, hydraulic pumps power consumptions, ABS energy consumption.

**UNIT - V VEHICLE COMPONENT RELATED TESTING 9**

Test Route selection, vehicle test speeds, cargo, weights, driver selection, Tested data, finding and calculations. Test on rough terrain, Pot hole with laden and unladen conditions.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Beck with. T.G. and Buck.N.L."Mechanical Measurements", Addition Wesley publishing company Limited, 1995.
2. Robert Bosch GmbH, —Automotive Hand Book, 9th Edition, Wiley, 2014. 2004
3. Tim Grilles, "Automotive Service" Delmar publishers, 1998

**REFERENCES:**

1. W.H. course& D.L. Anglin, "Automotive Mechanics" TMG publishing company, 2004
2. Judge A.W., —Modern Electrical Equipment of Automobiles: Motor Manuals Volume Six, 2nd Edition, Springer Science & Business Media, 2012.
3. Website: [www.mainindia.com/Draft, AIS standards. asp.](http://www.mainindia.com/Draft_AIS_standards.asp)

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

<b>Course Name : AUTOMOTIVE TESTING</b>												<b>Course Code : 20AE8A4</b>			
<b>CO</b>	<b>Course Outcomes</b>											<b>Unit</b>	<b>K-CO</b>	<b>POs</b>	<b>PSOs</b>
CO 1	Explain the vehicle for testing standards											1	K2	1,2,8	-
CO 2	Explain the vehicle body testing											1	K2	1,2,7,8,9	-
CO 3	Describe the vehicle test in static and dynamic conditions.											2	K2	1,2,7,8	-
CO 4	Explain all the automotive testing regulations while testing a vehicle.											3	K2	1,2,7,8	-
CO 5	Describe effectiveness and efficiency of all the components											4	K2	1,2,8,9	-
CO 6	Analyze the vehicle and report the results.											5	K4	1,2,3,7,8	-
<b>CO – PO MAPPING</b>															
<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
CO 1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	1	1	1	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 4	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-
CO 5	2	1	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 6	2	1	1	-	-	-	1	1	-	-	-	-	-	-	-

<b>20AE8A5</b>	<b>REGULATORY MECHANISM FOR TRANSPORTATION SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the transportation systems planning.
- To understand the traffic management.
- To understand the traffic survey methods.
- To explain the traffic control and regulation.

**PRE-REQUISITE: NIL****UNIT-I TRANSPORTATION SYSTEMS PLANNING 9**

Types of Road-Mode of Transport-Stages in Transportation Planning-Travel Forecasting Process-Modal split models – Mode choice behavior-Traffic assignment and methods-Land Use Transport Model. Urban Transport System-Bus Transit Planning And Scheduling-Rail Transit Terminals And Performance Evaluation-Policies and Strategies for Mass Transport.

**UNIT-II TRAFFIC MANAGEMENT AND STUDIES 9**

Scope, traffic elements, characteristics-vehicle, road user and road; traffic studies-speed & delay, traffic volume, O & D, parking and accidents, sample size, study methodology, data collection & presentation

**UNIT - III TRAFFICSURVEYS 9**

Methods of conducting the study and presentation of the data for traffic volume study; speed study and origin and destination study. Speed and delay study. Parking surveys; On street parking; off street parking. Accident surveys. Causes of road accidents and preventive measures; Use of photographic techniques in traffic surveys

**UNIT - IV TRAFFIC CONTROL AND SIGNAL DESIGN 9**

Types of traffic control devices. Traffic signs; general principles of traffic signing; types of traffic signs. Road markings; types; general principles of pavement markings. Design of rotary.Grade separated intersections. Miscellaneous traffic control aids and street furniture.

Types of signals. Linked or coordinated signal systems. Design of signal timings by trial cycle method; approximate method; Webster's method and IRC method

**UNIT - V TRAFFIC REGULATION AND MEASURES 9**

Need and scope of traffic regulations. Regulation of speed; vehicles and drivers. General traffic regulations. Motor vehicle act. Scope of traffic management. Traffic management measures:restrictions on turning movements; one way streets; tidal flow operations; exclusive bus lanes; traffic restraint; road pricing.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers.
2. Traffic Engineering - Theory & Practice - Louis J.Pignataro, Prentice Hall Publication.
3. "Highway Engineering", -Khanna S. K. and Justo C. E. G., Nem Chand Bros., Roorkee

**REFERENCES:**

1. Matson T. M., Smith W. S. and Hurd F. W., "Traffic Engineering", McGraw Hill, New York.
- 2.Principles of Highways Engineering and Traffic Analysis - Fred Mannering & Walter Kilareski, John Wiley & Sons Publication.
3. Transportation Engineering - An Introduction - C.JotinKhisty, Prentice Hall Publication
4. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>REGULATORY MECHANISM FOR TRANSPORTATION SYSTEMS</b>											Course Code : <b>20AE8A5</b>				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Describe the various traffic planning process.										1	K2	1,2,8,9	-	
CO 2	Explain the process of traffic management systems.										2	K2	1,2,8,9	-	
CO 3	Identify the various methods of traffic surveys.										3	K2	1,2,8,9	-	
CO 4	Explain the various traffic control devices.										4	K2	1,2,8,9	-	
CO 5	Explain the traffic signs for roads.										4	K2	1,2,8,9	-	
CO 6	Understand the various traffic regulations and its measures.										5	K2	1,2,9,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	-	-	1	2	-	-	-	-	-

<b>20ME7A2</b>	<b>COMPUTER INTEGRATED MANUFACTURING SYSTEMS</b>	<b>L 3</b>	<b>T 0</b>	<b>P 0</b>	<b>C 3</b>
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**OBJECTIVES:**

- To understand the application of computers in manufacturing systems.
- To know the concept of cellular manufacturing systems.
- To familiarize about FMS and its applications.
- To comprehend the application of automation and AGVS in industry.
- To know the application of computer for generating process planning of the product.

**PRE-REQUISITE:****Course Code: 20AE404****Course Name: Manufacturing Processes and Technology****UNIT-I INTRODUCTION TO CIM AND AUTOMATION 9**

Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, Computer Integrated manufacturing, computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in process, numerical problems.

**UNIT-II CELLULAR MANUFACTURING SYSTEMS 9**

Group technology-Part Families, Features and Optiz of Parts Classification and Coding Systems, Machine Cell Design, Applications Of Group Technology.Quantitative analysis of Cellular Manufacturing, Grouping of parts and Machines by Rank Order Clustering method - Hollier Method – Simple Problems.

**UNIT - III FLEXIBLE MANUFACTURING SYSTEMS 9**

FMS- Flexibility – Types of FMS- Components - work stations –FMS layout configurations- Computer control and functions –Applications.Analysis of flexible manufacturing systems – Bottleneck model – sizing the FMS –simple numerical problems.

**UNIT - IV AUTOMATED ASSEMBLY SYSTEMS AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) 9**

Automation – Basic elements- power - program of instructions – control system – levels of automation. Fundamentals of automated assembly systems – system configurations - parts delivery – applications. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

**UNIT - V COMPUTER AIDED PROCESS PLANNING SYSTEMS 9**

Computer aided Process Planning – Variant process planning – Generative process planning– Forward and backward planning, input format.Totally Integrated process planning systems – Expert process planning- Commercial systems: CAM-I, CAPP, MIPLAN, APPAS, CPPP.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education Limited, 5<sup>th</sup> Edition, 2019.
2. Radhakrishnan P, SubramanyanS.andRaju V., “CAD/CAM/CIM”, New Age, International (P) Ltd, 4<sup>th</sup> Edition, 2016.
3. James A. Rehg, and Henry W Kraebber, ‘Computer-Integrated Manufacturing’, Pearson Education Limited, 2<sup>nd</sup> Edition, 2000.

**REFERENCES:**

1. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach”, Chapman & Hall, 1995.
3. Rao. P, N Tewari&T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill, Publishing Company, 2000.
4. Vollmann, T.E. and Bery, W.E., “Manufacturing Planning and Control Systems, Galgotia Publications, 5<sup>th</sup> Edition, 2004.
5. YoramKoren, ‘Computer Control of Manufacturing Systems’, McGraw Hill Education, Indian Edition, 2017.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>COMPUTER INTEGRATED MANUFACTURING SYSTEMS</b>		Course Code : <b>20ME7A2</b>													
CO	Course Outcomes	Unit	K-CO	POs	PSOs										
CO 1	Explain the knowledge about role of computer and automation in manufacturing.	1	K2	1,2,8	-										
CO 2	Explain the concept of group technology, and analysis of cellular manufacturing cell.	2	K2	1,2,8,9	-										
CO 3	Explain the concept of FMS, and sizing of FMS systems.	3	K2	1,2,8,10	-										
CO 4	Describe the automation, types of automation and automation strategies.	4	K2	1,2,8,9	-										
CO 5	Describe Automated Guided Vehicle System and its application.	4	K2	1,2,8	-										
CO 6	Describe the application of computer in CAPP, and explore to integrated planning software.	5	K2	1,2,8	-										
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	-	2	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	-	2	-	1	-	-	-	-	-
CO 4	2	1	-	-	-	-	-	1	1	-	-	-	-	-	-
CO 5	2	1	-	-	-	-	-	2	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-

**OPEN ELECTIVE – I OFFERED TO OTHER DEPARTMENT**

<b>20OE601</b>	<b>FUNDAMENTALS OF ELECTRIC VEHICLES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To know the history of Electric vehicles (EV) and emphasize the need and importance of EV for sustainable future.
- To develop a thorough understanding of the key elements of EV : Electric Machines for Propulsion applications and Energy Storage devices.
- To understand the architecture of hybrid electric vehicles.

**PRE-REQUISITE: NIL****UNIT-I INTRODUCTION 9**

Internal Combustion(IC) Engine – Construction- Fuels for IC engine- Emission from IC Engine. Power train: Electric motor — Need- Cost and Emissions- Comparison of Electric (EV) and IC Engine Vehicle. Social and environmental importance of Electric vehicles, Impact of modern drive- Trains on energy supplies.

**UNIT-II ELECTRIC VEHICLE 9**

Basics of vehicle mechanisms, history of electric vehicles (EV), Electric vehicle Architecture: Major components of electric vehicle .Power/Energy supplies requirements for EV applications, vehicle power source characterization, and transmission characteristics.

**UNIT - III HYBRID ELECTRIC VEHICLE 9**

Hybrid Electric vehicles — Classification — Micro, Mild, Full, Plug-in - EV Layout and Architecture – Series, Parallel and Series-Parallel Hybrid, Regenerative Braking

**UNIT - IV ENERGY STORAGE FOR EV 9**

Energy storage- Battery based and Fuel cell based, Battery parameters, Types of Batteries, Modeling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, ultra- capacitors as energy sources for EV.

**UNIT - V ELECTRIC PROPULSION 9**

Electric Propulsion EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Mehrdad Ehsani, YiminGao, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design, CRC Press, New York, Third Edition,2019.
2. S. S. Thipse, “Alternative Fuels”, Jaico Publications, First Edition 2010
3. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals, CRC Press, New York, Second Edition,2003.

**REFERENCES:**

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley & SonsLtd., England, Second Edition,2012.
2. Sandeep Dhameja, Electric Vehicle Battery Systems, Newness, Massachusetts, 2002.
3. Dr Mike Westbrook, M H Westbrook, The Electric Car: Development & Future of Battery, Hybrid & Fuel-Cell Cars, British library Cataloguing in Publication Data, First Edition, 2001

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : FUNDAMENTALS OF ELECTRIC VEHICLES											Course Code : 20OE601				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Describe the history and evolvement of electric & hybrid electric vehicles										1	K2	1,2,7,8	-	
CO 2	Explain the principles of various EV drive train.										2	K2	1,2,7,8	-	
CO 3	Select electric propulsion system components for EV drives suitability for the desirable performance and control.										3	K2	1,2,7,8,9	-	
CO 4	Compare and evaluate various energy sources and energy storage components for EV and applications										4	K2	1,2,7,8	-	
CO 5	Explain the types of electric motor drives for EV.										5	K2	1,2,7,8,9	-	
CO 6	Recognize the need to adapt technological changes in the transportation system for sustainable future.										5	K3	1,2,7,8	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	1	1	1	-	-	-	-	-	-
CO 4	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-
CO 5	2	1	-	-	-	-	1	1	1	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-

**200E602 SUPPLY CHAIN MANAGEMENT**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To study about the role and drivers of and supply chain management.
- To explain about Supply Chain Network Design.
- To illustrate about the issues related to Logistics in Supply Chain.
- To appraise about Sourcing and Coordination in Supply Chain.
- To study about the application of Information Technology and Emerging Concepts in Supply.

**PRE-REQUISITE: NIL**

**UNIT-I INTRODUCTION 9**

Supply Chain Management concepts and Definitions — Objectives and Components of Supply chain- Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies — Drivers of Supply Chain Performance and Obstacles.

**UNIT-II SUPPLY CHAIN NETWORK DESIGN 9**

Role of Distribution in Supply Chain — Factors influencing Distribution network design — Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain — Framework for network Decisions

**UNIT - III LOGISTICS IN SUPPLY CHAIN 9**

Role of transportation in supply chain – factors affecting transportations decision – Designoption for transportation network – Tailored transportation – Routing and scheduling in transportation.

**UNIT - IV SOURCING AND COORDINATION IN SUPPLY CHAIN 9**

Role of sourcing supply chain supplier selection assessment and contracts- Designcollaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect— Effect of lack of co-ordination in supply chain and obstacles — Building strategicpartnerships and trust within a supply chain.

**UNIT - V SUPPLY CHAIN AND INFORMATION TECHNOLOGY 9**

The role of IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education, Sixth edition, 2016.
2. Janat Shah, Supply Chain Management – Text and Cases, Pearson Education, First edition, 2009.
3. James B. Ayers, "Handbook of Supply Chain Management", St. Lucie press, Second edition, 2006.

**REFERENCES:**

1. Jeremy F. Shapiro, "Modeling the Supply Chain", Thomson Duxbury, Second edition, 2006
2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2010  
David J. Bloomberg, Stephen Lemay and Joe B. Hanna, "Logistics", PHI 2010.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : SUPPLY CHAIN MANAGEMENT										Course Code : 20OE602					
CO	Course Outcomes										Unit	K-CO	Pos	PSOs	
CO 1	Explain the framework and scope of supply chain functions.										1	K2	1,2,8	-	
CO 2	Explain the principles of supply chain management										2	K2	1,2,8	-	
CO 3	Design, organize and manage a supply network considering various logistics issues										3	K2	1,2,8	-	
CO 4	Apply forecasting and purchasing/Inventory concepts to improve supply chain operations										4	K2	1,2,8	-	
CO 5	Explain logistics technology tools and resources										5	K2	1,2,8	-	
CO 6	Apply internet technology systems to support logistics management decisions.										5	K3	1,2,8	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 3	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 4	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 5	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO 6	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-

<b>20OE603</b>	<b>AUTOMOTIVE SAFETY SYSTEM</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand automotive safety in the broader context of transportation safety.
- To impart knowledge on the different types of active and passive safety system used in automobiles.
- To explain the different types of vehicle safety systems used in automobiles.
- To examine the collision warning and avoidance systems in automobiles.
- To provide knowledge on the different comfort and convenience system used in automobiles

**PRE-REQUISITE: NIL****UNIT-I INTRODUCTION 9**

Automotive safety: Introduction, Types. Active safety: driving safety, conditional safety, Perceptibility safety, operating safety. Passive safety: exterior safety, interior safety.

**UNIT-II PASSIVE SAFETY CONCEPTS 9**

Design of body for safety, deceleration of vehicle, passenger. Concept of crumple zone, Safety Cage. Deceleration on impact with stationary and movable obstacles. Deformation behaviour of vehicle body. Barrier test. Crash tests. Deformation behaviour of Lightweight materials

**UNIT - III PASSIVE SAFETY EQUIPMENTS AND CONVENIENCE SYSTEM 9**

Seat belt, Seat belt tightener system and importance, collapsible steering column. Air bags and its activation. Designing aspects of automotive bumpers and materials for bumpers. Adaptive front lighting, central locking system, Tire pressure control system, rain sensor system with automated wiper system.

**UNIT - IV ACTIVE SAFETY 9**

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

**UNIT - V VEHICLE INTEGRATION AND NAVIGATION SYSTEM 9**

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

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Bosch, “Automotive Handbook”, 10<sup>th</sup> Edition, SAE publication,2018.
2. George. A.Peters, Barbara. J.Peters, Automotive Vehicle Safety, CRC Press, FirstEdition, 2002.
3. Robert Bosch GmbH - “Safety, Comfort and Convenience Systems”- Wiley; 3rd edition,2007

**REFERENCES:**

1. Mark Gonter and Ulrich Seiffert, —Integrated Automotive Safety Handbookll, SAE Publication, 2013.
2. J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori - “Sensors for Automotive Applications “ WILEYVCH Verlag GmbH & Co. 2003
3. Ronald.K.Jurgen - “Automotive Electronics Handbook” - Second edition- McGraw-Hill Inc., -1999.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : AUTOMOTIVE SAFETY SYSTEM										Course Code : 20OE603					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Describe the concepts of safety measures in automobiles.										1	K2	1,2,3,9	-	
CO 2	Explain the concept of crumble zone										2	K2	1,2,10	-	
CO 3	Describe the vehicle structure with respect to crash worthiness										3	K2	1,2,3,9	-	
CO 4	Explain the working of passive safety components such as air bags, seatbelts										4	K2	1,2,3,10	-	
CO 5	Explain the different types of active safety system used in automobiles.										5	K2	1,2,3,9	-	
CO 6	Describe Vehicle integration and navigation system.										5	K3	1,2,3,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 2	3	2	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 3	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 4	3	2	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 5	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 6	3	2	1	-	-	-	-	-	-	1	-	-	-	-	-

<b>20OE604</b>	<b>BASICS OF AUTOMOBILE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To familiarize Working of SI & CI engine
- To understand the working of various fuel systems.
- To explain the working of ignition, cooling and lubrication systems
- To explain the suspension and brake system used two and four wheeler

**PRE-REQUISITE: NIL**

**UNIT-I ENGINE CONSTRUCTION AND OPERATION 9**

Constructional details of spark ignition (SI) and compression ignition (CI) engines-Working principles. Two stroke SI and CI engines — construction and working. Comparison of SI and CI engines and four stroke and two stroke engines. Engine classification, firing order.

**UNIT-II FUEL SYSTEMS 9**

Air fuel ratio requirements of SI engines, Air fuel ratio and emissions, Working of a simple fixed venture carburetor, Constant vacuum carburetor. MPFI. Gasoline direct injection systems. Diesel fuel injection systems- Jerk pumps, distributor pumps, pintle and multi hole nozzles, Unit injector and CRDI systems. Need for a governor for diesel engines. Description of a simple diesel engine governor.

**UNIT - III IGNITION SYSTEMS 9**

Components and working of battery coil and magneto–ignition system, electronic ignition system, capacitive discharge ignition system, distributor less ignition system, digital ignition system, direct ignition system, ignition triggering devices, centrifugal and vacuum advance mechanisms. Spark plug — Construction, working and types.

**UNIT - IV COOLING AND LUBRICATION SYSTEMS 9**

Need for cooling, types of cooling systems- air and liquid cooling systems. Thermo siphon and forced circulation and pressurized cooling systems. Properties of coolants. Requirements of lubrication systems. Types- mist, pressure feed, dry and wet sump systems. Properties of lubricants.

**UNIT - V TWO AND FOUR WHEELER 9**

Two wheeler Suspension Systems- Front and rear suspension systems. Shock absorbers. Four wheeler Suspension Systems -conventional Suspension Systems -independent Suspension Systems –leaf spring — coil spring

Two wheeler Brake system - Drum brakes & Disc brakes Construction and Working and its Types, Front and Rear brake links lay-outs for two wheeler -. Brake actuation mechanism.

Four wheeler Brake System -Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), Construction and Working of Four wheeler Power Steering.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Ganesan V. "Internal Combustion Engines", Fourth Edition, Tata McGraw-Hill, 2017  
2. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, 13 Edition, Standard Publishers, New Delhi, 2013.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, NewDelhi, 2002

**REFERENCES:**

1. Ramalingam. K. K., "Two Wheelers", Scitech publications, Chennai,2018
2. G.B.S. Narang"Automobile Engineering"5th Edition, Khanna Publishers,Delhi,2010
3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 2006.
4. Irving,P.E.," Motor cycle Engineering", Temple Press Book, London, 1992.
5. Bryaut, R.V., Vespa "Maintenance and Repair series".
6. Marshall Cavendish, Encyclopedia of Motor cycling, 20 volumes, New York andLondon

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : BASICS OF AUTOMOBILE ENGINEERING										Course Code : 20OE604					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Recognize the construction and working principle of SI and CI engines.										1	K2	1,2,3,9	-	
CO 2	Describe about the fuel system and fuel pumps used in automotive engines.										2	K2	1,2,3,10	-	
CO 3	Explain basic concepts of ignition systems.										3	K2	1,2,3,9	-	
CO 4	Explain about working of engine cooling and lubrication systems.										4	K2	1,2,3,10	-	
CO 5	Explain the suspension and brake system used in two and four wheeler.										5	K2	1,2,3,9	-	
CO 6	Conversant with basics of automobile systems.										5	K3	1,2,3,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 2	2	1	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 3	2	1	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 4	2	1	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 5	2	1	1	-	-	-	-	-	2	-	-	-	-	-	-
CO 6	2	1	1	-	-	-	-	-	-	1	-	-	-	-	-

**OPEN ELECTIVE – II OFFERED TO OTHER DEPARTMENT**

<b>20OE605</b>	<b>LEAN MANUFACTURING PRACTICES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To study the various tools for lean manufacturing
- To apply the above tools to implement lean manufacturing system in an organization
- To understand the problem solving methodology in Industries

**PRE-REQUISITE: NIL**

**UNIT-I INTRODUCTION TO LEAN MANUFACTURING 9**  
TQM – Basic concepts, need - Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

**UNIT-II TYPES OF LAYOUT, JIT, TPM 9**  
Layout types – Product, Process, Cellular Manufacturing –, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

**UNIT - III SMED, 5S, VSM 9**  
Set up time reduction – Definition, philosophies and reduction approaches. 5S Principles and implementation - Value stream mapping - Procedure and principles, Kaizen.

**UNIT - IV SIX SIGMA 9**  
Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation

**UNIT - V CASE STUDIES 9**  
Problem solving methodology, Case studies of implementation of lean manufacturing at industries.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Design and Analysis of Lean Production Systems, Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & Sons, 2003
2. Automation, Production Systems and CIM. Mikell P. Groover (2002), Prentice hall Publications
3. Rother M. and Shook J, 1999 \_Learning to See: Value Stream Mapping to Add Value and Eliminate Muda', Lean Enterprise Institute, Brookline, MA.

**REFERENCES:**

1. Simplified Lean Manufacture , N.Gopalakrishnana, PHI Learning PvtLTd, New Delhi
2. Production planning and control , Dr.V.Jeyakumar, Lakshmi publication
3. Total Quality Management , Dr.V.Jeyakumar , Lakshmi publication

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : <b>LEAN MANUFACTURING PRACTICES</b>											Course Code : <b>20OE605</b>				
CO	Course Outcomes										Unit	K-CO	POs	PS Os	
CO 1	Understand the principles, elements and various tools of lean manufacturing										1	K2	1,2,3,4,10	-	
CO 2	Understand the different types of layout, cellular manufacturing, implementation of JIT, Kanban, TPM										2	K2	1,2,3,4,10	-	
CO 3	Apply the concepts of SMED,5S in Industries										3	K3	1,2,3,4,10	-	
CO 4	Apply the concepts TQM and VSM.										3	K3	1,2,3,4,10	-	
CO 5	Understand the DOE and six sigma implementation										4	K2	1,2,3,4,10	-	
CO 6	Solve problems using appropriate lean tools										5	K3	1,2,3,4,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 2	2	1	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 3	2	1	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 4	2	1	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 5	2	1	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 6	2	1	2	1	-	-	-	-	-	2	-	-	-	-	-

<b>20OE606</b>	<b>MODERN VEHICLE TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To impart recent trending knowledge in the Automobile field.
- To develop the skills of the students in recent safety precaution principles
- To Improve efficiency, security & performance of automobile using modern electronics and technology.

**PRE-REQUISITE: NIL****UNIT-I ELECTRONIC ENGINE MANAGEMENT 9**

Single Point and Multipoint Injection System, Working of Electronic Fuel Injector, Different Types of Electronic Fuel Injection Systems Like L, K, KE, LU, LH and Motronic, ME & MH Systems, Cylinder Cut-Off Technology.

**UNIT-II DRIVER INFORMATION SYSTEMS 9**

Introduction, Driver Support Systems – Driver Information, Driver Perception, Driver Convenience, Driver Monitoring. Vehicle Support Systems – General Vehicle Control, Collision Avoidance, Vehicle Status Monitoring.

**UNIT - III DRIVER ASSISTANCE SYSTEMS 9**

Global Positioning Systems, Geographical Information Systems, Navigation Systems, Automotive Vision System, Road Recognition, Driver Assistance Systems - Connected Vehicles, Autonomous Vehicles

**UNIT - IV SAFETY SYSTEMS 9**

Active and Passive Safety Systems, Airbags, Seat Belt Tightening System, Collision Warning Systems, Child Lock, Anti Lock Braking Systems, Traction Control, Electronic Stability Programme. Crash Worthiness of Vehicle, Vehicle Crash Testing, Testing With Dummies. Security Systems - Anti Theft Technologies, Smart Card System, Number Plate Coding.

**UNIT - V COMFORT SYSTEMS 9**

Active Suspension Systems, Requirement and Characteristics, Different Types, Power Steering, Collapsible and Tiltable Steering Column, Power Windows, Biometric Systems. Adaptive Control Systems: Adaptive Cruise Control, Adaptive Noise Control, Anti Spin Regulation.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. K.K. Ramalingam, "Automobile Engineering", Scitech Publications Pvt. Ltd., 2005
2. Crouse/Anglin "Automotive Mechanics"
3. "Automotive technology" H.Hertz, 2008

**REFERENCES:**

1. Beranek. L.L. Noise Reduction, McGraw-Hill Book Co., Inc, Newyork, 1993
2. Bosch Hand Book, 3rd Edition, SAE, 1993
3. T. Kenneth Garrett, Kenneth Newton and William Steeds, "The Motor Vehicle" 13th Edition, Butterworth-Heinemann Limited, London, 2005.

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : MODERN VEHICLE TECHNOLOGY											Course Code : 200E606				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the recent developments in Alternate power generation for a vehicle.										1	K 2	1,2,3,10	-	
CO 2	List various modern features for better functioning of vehicle.										2	K 2	1,2,3,10	-	
CO 3	Demonstrate the advanced suspension, Braking, and Safety systems in automobile.										3	K 2	1,2,3,10	-	
CO 4	Identify the Various Vehicle operation and control systems.										4	K 2	1,2,3,10	-	
CO 5	Explain the Driver support systems in Vehicle automated tracks.										4	K 2	1,2,3,10	-	
CO 6	Identify and describe various advanced comfort system used in automobile										5	K 2	1,2,3,10	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 6	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-

<b>20OE607</b>	<b>NEW GENERATION HYBRID VEHICLES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To illustrate the new generation vehicles and their operation and controls
- To give an exposure regarding types of Power system and new generation vehicles.
- To give an exposure regarding the various types of Vehicle automated tracks.
- To teach the basics of suspension, brakes, aerodynamics and safety.

**PRE-REQUISITE: NIL**

**UNIT-I INTRODUCTION 9**

Electric and hybrid vehicles, flexible fuel vehicles (FFV), flexible fuel systems, solar powered vehicles, fuel cells and its type, fuel cell vehicles

**UNIT-II POWER SYSTEM AND NEW GENERATION VEHICLES 9**

Hybrid Vehicle engines, Stratified charge engines, lean burn engines, low heat rejection engines, hydrogen engines, HCCI engine, VCR engine, surface ignition engines, VVTI engines. High energy and power density batteries

**UNIT - III VEHICLE OPERATION AND CONTROL 9**

Computer Control for pollution and noise control and for fuel economy – Transducers and actuators - Advanced Driver Assistance System Technology- Connected Car Technology.

**UNIT - IV VEHICLE AUTOMATED TRACKS 9**

Preparation and maintenance of proper road network using Intelligent Transportation System (ITS)–Components of ITS- National highway network with automated roads and vehicles – Satellite control of vehicle operation for safe and fast travel, GPS.

**UNIT - V SUSPENSION, BRAKES AND SAFETY 9**

Air suspension – Closed loop suspension, compensated suspension, anti skid braking system, retarders, regenerative braking, safety gauge air bags- crash resistance. Safety systems

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Bosch Hand Book, SAE Publication, 2000
2. Heinz, "Modern Vehicle Technology" Second Edition
3. Advance hybrid vehicle power transmission, SAE.

**REFERENCES:**

1. Advance hybrid vehicle power transmission, SAE.
2. Light weight electric for hybrid vehicle design.
3. Noise reduction, Branek L.L., McGraw Hill Book company, New York, 1999

**OUTCOMES:  
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name: <b>NEW GENERATION HYBRID VEHICLES</b>										Course Code : <b>200E607</b>					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Interpret the critical comparisons of HEVs with alternatives such as EVs and fuel cell systems.										1	K2	1,2,3,9	-	
CO 2	Define and analyze the fundamental operations of different hybrid engines and the electrochemistry of battery operation.										2	K3	1,2,3,10	-	
CO 3	Explain different approaches to control the vehicles with the aid of computer and Information Technology.										3	K3	1,2,3,10	-	
CO 4	Identify how to prepare and maintain Road network using satellite and GPS control.										4	K3	1,2,3,9	-	
CO 5	Demonstrate the safety features of vehicles										5	K3	1,2,3,9	-	
CO 6	Identify and describe materials used for safety precautions in vehicles.										5	K3	1,2,3,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	-	-	-	-	-	1	2	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	1	2	-	-	-	-	-
CO 5	3	3	2	-	-	-	-	-	1	2	-	-	-	-	-
CO 6	3	3	2	-	-	-	-	-	1	2	-	-	-	-	-

<b>20OE608</b>	<b>AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the need for alternator in the vehicle.
- To understand the need for storage batteries and starter motor
- To explain the different types of electronic ignition systems
- To list common types of sensor and actuators used in vehicles.
- To explain the different safety systems used in vehicles.

**PRE-REQUISITE: NIL**

**UNIT-I CHARGING SYSTEM, LIGHTING SYSTEM AND ACCESSORIES SYSTEM 9**

Introduction about electrical and electronics in automobiles. DC Generators and Alternators their characteristics. Voltage and Current Regulation, Cut –out relays and regulators Control unit –electronic regulators. Vehicle interior and exterior lighting systems. Wiring requirements, lighting design. Dashboard instruments - (fog lamps, auxiliary lighting, temperature gauge, oil pressure gauge, fuel gauge, speedometer, odometer, horn, windscreen wiper signaling devices and trafficator)

**UNIT-II BATTERIES AND STARTING 9**

Types of Batteries – principle, rating, testing and charging, new developments in electrical storage batteries. Starter motors characteristics, principle and construction of starter motor, drive mechanisms, capacity requirements, servicing and trouble shooting, starter switches and solenoids.

**UNIT - III ELECTRONIC IGNITION AND INJECTION SYSTEM 9**

Conventional ignition system and its components, Electronic, Programmed, Distributor less and direct injection systems, spark advance and retard mechanisms. Types of spark plugs. Types of fuel injection in Petrol and Diesel engines.

**UNIT - IV SENSORS, CONTROLLER AND ACTUATORS 9**

Types of sensors – Vehicle speed sensor, Oxygen sensor (Lambda sensor), pressure sensor, Hot wire anemometer sensor, Knock sensor, Throttle position sensor, Crank position sensor. Electronic Control Module (ECM). Types of actuators- Exhaust gas recirculation, idle speed, ignition controller, (SI Engines), Injection control and ABS actuator. Applications - Keyless entry system, Electronic suspension system, Electronic steering system.

**UNIT - V SAFETY SYSTEMS 9**

Antilock braking system, Air bag restraint system, Voice warning system, Seat belt system, Road navigation system, Obstacle avoidance radar system, Alarms and immobilizer system.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. TOM Denton, —Automobile Electrical and Electronic Systems, 3rd Edition, Elsevier Butterworth – Heinemann Publications, 2004.
2. William B. Ribbens, — Understanding Automotive Electronics, 5th Edition, Butterworth –Heinemann Publications, 1998.
3. Kholi .P.L. Automotive Electrical Equipment, Tata McGraw-Hill co Ltd, New Delhi, 2004

**REFERENCES:**

1. Judge A.W., —Modern Electrical Equipment of Automobiles: Motor Manuals Volume Six, 2nd Edition, Springer Science & Business Media, 2012.
2. Robert Bosch GmbH, —Automotive Hand Book, 9th Edition, Wiley, 2014. 2004.
3. AdityaP.Mathur, —Introduction to Microprocessors, 3rd Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1989.

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS											Course Code : 20OE608				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
CO 1	Explain the working of charging, lighting and miscellaneous systems involved in automobiles.										1	K2	1,2,3,4,9	-	
CO 2	Explain the battery types and components involved in starting system.										2	K2	1,2,3,4,1	-	
CO 3	Describe the types of ignition and injection systems of IC engine.										3	K2	1,2,3,4,9	-	
CO 4	Determine the function and operation of sensors and actuators and have a good knowledge of how they are used in the management of the vehicle control.										4	K2	1,2,3,4,9	-	
CO 5	Explain the working and applications of Keyless entry system, Electronic suspension system, Electronic steering system.										4	K2	1,2,3,4,1	-	
CO 6	Identify the various safety systems of automobiles and their working.										5	K2	1,2,3,4,9	-	
CO – PO MAPPING															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 2	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 4	3	2	2	1	-	-	-	-	2	-	-	-	-	-	-
CO 5	3	2	2	1	-	-	-	-	-	2	-	-	-	-	-
CO 6	3	2	2	1	-	-	-	-	1	-	-	-	-	-	-