

**HINDUSTHAN**  
**COLLEGE OF ENGINEERING AND TECHNOLOGY**  
(An Autonomous Institution)  
Coimbatore – 641032

**DEPARTMENT OF AUTOMOBILE ENGINEERING**

**Curriculum and ODD Semesters Syllabus for the Batch**

**2024 – 2028 (R2022)**

**2023 – 2027 (R2022)**

**2022 – 2026 (R2022)**

**2021 – 2025 (R2019 with Amendments)**

**(Board of Studies held on 20.05.2024)**

**(Academic Council Meeting held on 21.06.2024)**

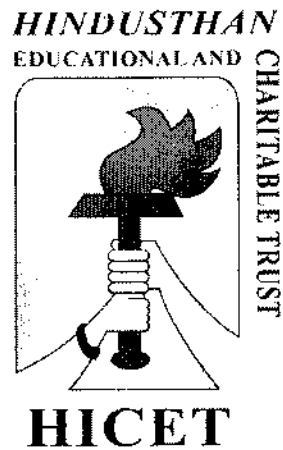


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***HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY***  
(An Autonomous Institution Affiliated to Anna University, Chennai)  
(Approved by AICTE, New Delhi, Accredited by NAAC with 'A' Grade)  
Coimbatore - 641 032.

**B.E. AUTOMOBILE ENGINEERING**



**CHOICE BASED CREDIT SYSTEM**

**Curriculum under R2022**  
**(for the batch admitted during 2024 – 2025)**



# **CURRICULUM Regulation - 2022**



**DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS**

**CBCS PATTERN**

**UNDERGRADUATE PROGRAMMES**

**B.E. AUTOMOBILE ENGINEERING (UG)**

**REGULATION-2022**

For the students admitted during the academic year 2024-2025 and onwards

**SEMESTER I**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2	22ME1201	Engineering Drawing	ESC	1	2	0	3	5	40	60	100
3	22AU1201	Fundamentals of Automobile Engineering	BSC	2	0	2	3	4	50	50	100
<b>THEORY WITH LAB COMPONENT</b>											
4	22PH1153	Physical properties of materials	BSC	2	0	2	3	4	50	50	100
5	22HE1151	English for Engineers	HSC	2	0	2	3	4	50	50	100
<b>EEC COURSES (SE/AE)</b>											
6	22HE1072	ENTREPRENEURSHIP & INNOVATION (Common to all branches)	AEC	1	0	0	1	1	100	0	100
7	22HE1073	Introduction to Soft Skills	SEC	2	0	0	0	0	100	0	100
<b>MANDATORY COURSE</b>											
8.	22MC1093/ 22MC1094	தமிழர் மரபு / Heritage of Tamils	MC	2	0	0	1	2	0	0	0
9.	22MC1095	Universal Human Values	MC	2	0	0	0	2	0	0	0
<b>TOTAL</b>				<b>17</b>	<b>5</b>	<b>6</b>	<b>18</b>	<b>27</b>	<b>770</b>	<b>330</b>	<b>700</b>

**SEMESTER II**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1	22MA2101	Differential equations and complex analysis	BSC	3	1	0	4	4	40	60	100
2	22PH2101	Basics of material science	BSC	2	0	0	2	3	40	60	100
3	22CY2101	Environmental Studies	ESC	2	0	0	2	3	40	60	100
4	22ME2101	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100



6	22CY2152	Applied Chemistry	BSC	2	0	2	3	4	50	50	100
<b>PRACTICAL COURSES</b>											
7	22ME2001	Engineering Practices	ESC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8	22HE2071	Design Thinking	AEC	1	0	2	2	2	100	0	100
9	22HE2072	Soft Skills and Aptitude -I	SEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSE</b>											
10.	22MC2094/ 22MC2095	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	MC	2	0	0	1	2	0	0	0
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
<b>TOTAL</b>				<b>18</b>	<b>1</b>	<b>10</b>	<b>23</b>	<b>26</b>	<b>520</b>	<b>380</b>	<b>900</b>

### SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA3104	Fourier analysis and numerical techniques	BSC	3	1	0	4	4	40	60	100
2.	22AU3201	Fundamentals of Automotive Engines	PCC	3	0	0	3	3	40	60	100
3.	22AU3202	Fundamentals of Thermodynamics	PCC	3	1	0	4	3	40	60	100
4.	22AU3203	Mechanics of Materials	PCC	3	1	0	4	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5.	22AU3251	Manufacturing Technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
6.	22AU3001	Automotive Components Lab	ESC	0	0	4	2	4	60	40	100
7.	22AU3002	Mechanics of Materials Lab	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE3071	Soft Skills -2	SEC	1	0	0	1	1	100	0	100
9.	22AU3072	Machine Drawing	AEC	0	0	4	2	2	60	40	100
10.	22MC3092	Essence of Indian Traditional Knowledge	AEC	2	0	0	0	0	-	-	-
<b>TOTAL</b>				<b>19</b>	<b>3</b>	<b>10</b>	<b>25</b>	<b>29</b>	<b>470</b>	<b>430</b>	<b>900</b>

### SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2.	22AU4201	Automotive Chassis components Design	BSC	3	0	0	3	3	40	60	100
3.	22AU4202	Automotive Electricals and Electronics systems	PCC	3	1	0	4	3	40	60	100
4.	22AU4203	Mechanics of Machines	PCC	3	1	0	4	4	40	60	100
5.	22AU4204	Fluid and Pneumatic systems	PCC	3	0	0	3	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU4251	Fundamentals of Heat Transfer	PCC	3	0	0	3	4	40	60	100
<b>PRACTICAL</b>											
7.	22AU4001	Automotive Electricals and Electronics Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU4002	Computer Aided Engine components design Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE4071	Soft Skills -III	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>2</b>	<b>8</b>	<b>24</b>	<b>29</b>	<b>460</b>	<b>440</b>	<b>900</b>
<p>* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same will be evaluated in Semester IV.                      If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed with Internship II (Total: 4 weeks-2 credits)</p>											

### SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU5201	Vehicle design and data characteristics	PCC	3	0	0	3	4	40	60	100
2.	22AU5202	Automotive Fuels and Lubricants	PCC	3	0	0	3	3	40	60	100
3.	22AU53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	22AU53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	22AU53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU5251	Two and Three-wheeler technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
7.	22AU5001	Automotive Fuels and Lubricants Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>6</b>	<b>21</b>	<b>25</b>	<b>410</b>	<b>390</b>	<b>800</b>

### SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU6201	Design of Automotive Transmission systems	PCC	3	0	0	3	3	40	60	100
2.	22HE6101	Professional Ethics (Common)	HSC	3	0	0	3	3	40	60	100
3.	22AU63XX	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4.	22AU63XX	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5.	22XX64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6.	22XX64XX	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
7.	22AU6001	Computer Aided Engineering Laboratory	PCC	0	0	4	2	4	60	40*	100
8.	22AU6002	Engine Performance and Emission testing laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE6071	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
<b>TOTAL</b>				<b>20</b>	<b>0</b>	<b>8</b>	<b>24</b>	<b>28</b>	<b>460</b>	<b>440</b>	<b>900</b>

### SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU7201	Vehicle Dynamics	PCC	3	0	0	3	3	40	60	100
2.	22AU7202	Engine and Vehicle Management systems	PCC	3	1	0	4	4	40	60	100
3.	22AU73XX	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
4.	22XX7401	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5.	22LS74XX	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
6.	22AU7001	Vehicle Maintenance Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
7.	22AU7701	Internship - II*	SEC	-	-	-	2	1	100	0	100
<b>TOTAL</b>				<b>15</b>	<b>1</b>	<b>4</b>	<b>20</b>	<b>21</b>	<b>360</b>	<b>340</b>	<b>700</b>
* - Two weeks internship carries 1 credit and it will be done during Semester VI summer vacation/placement training and same will be evaluated in Semester VII.											

### SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	UA	ESE	Total
<b>EEC COURSES (SE/AE)</b>											
1.	22AU8901	Project Work/Granted Patent	SEC9	0	0	20	10	20	100	100	200
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>	<b>20</b>	<b>100</b>	<b>100</b>	<b>200</b>

**Note:**

- \*As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
- NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
- The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22.

### SEMESTER-WISE CREDIT DISTRIBUTION

<b>B.E. / B.TECH. PROGRAMMES</b>										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	-	-	-	-	-	20
3	ESC	6	5	2	-	-	-	-	-	15
4	PCC	-	-	16	20	12	7	9	-	64
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	6	6	-	12
7	EEC	2	3	3	1	1	2	2	10	25
8	MCC	✓	✓	-	-	-	-	-	-	-
<b>Total</b>		<b>18</b>	<b>22</b>	<b>25</b>	<b>24</b>	<b>21</b>	<b>24</b>	<b>20</b>	<b>10</b>	<b>165</b>

#### OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3
4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

### OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD  
TECH, E&I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Biorefinery	OEC	3	0	0	3	3

**Note:** Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

### OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU7401	Automotive Fault diagnosis systems	OEC	3	0	0	3	3

### OPEN ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3

5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1 Modern Mobility Systems	Vertical 2 Product and Process Development	Vertical 3 Robotics and Automation	Vertical 4 Digital and Green Manufacturing	Vertical 5 Clean and Green Energy Technologies	Vertical 6 Core Elective
22AU5301 Automotive Materials, Design and Testing	22AU5304 Value Engineering	22AU5307 Sensors and Instrumentation	22AU5310 Digital Manufacturing and IoT	22AU5313 Bioenergy Conversion Technologies	22AU5316 Automotive Chassis
22AU5302 Futuristic Vehicle Technology	22AU5305 Additive Manufacturing	22AU5308 Electrical Drives and Actuators	22AU5311 Lean Manufacturing	22AU5314 Solar Thermal Technology	22AU5317 Automotive Transmission
22AU5303 Renewable Energy and Emission Control Technology for Off Road Vehicles	22AU5306 CAD/CAM	22AU5309 Embedded Systems and Programming	22AU5312 Modern Robotics	22AU5315 Energy Conservation in Industries	22AU5318 Alternate Fuels and Energy Systems
22AU6301 Vehicle Health Monitoring, Maintenance and Safety	22AU6303 Ergonomics in Design	22AU6305 Robotics	22AU6307 Green Manufacturing Design and Practices	22AU6309 Energy Efficient Buildings	22AU6311 Automotive Engine Components design
22AU6302 Hybrid and Electric Vehicle Technology	22AU6304 New Product Development	22AU6306 Smart Mobility and Intelligent Vehicles	22AU6308 Environment Sustainability and Impact Assessment	22AU6310 Renewable Energy Technologies	22AU6312 Finite Element Analysis
22AU7301 Thermal Management of Batteries and Fuel Cells	22AU7302 Product Life Cycle Management	22AU7303 Haptics and Immersive Technologies	22AU7304 Green Supply Chain Management	22AU7305 Equipment for Pollution Control	22AU7306 Automotive Pollution and Control

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

#### Details of Vertical I: MODERN MOBILITY SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATEG ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5301	Automotive Materials, Components, Design & Testing	PEC	3	0	0	3	3
2	22AU5302	Conventional and Futuristic Vehicle Technology	PEC	3	0	0	3	3
3	22AU5303	Renewable Powered Off Highway Vehicles and Emission Control Technology	PEC	3	0	0	3	3

4	22AU6301	Vehicle Health Monitoring, Maintenance and Safety	PEC	3	0	0	3	3
5	22AU6302	Hybrid and Electric Vehicle Technology	PEC	3	0	0	3	3
6	22AU7301	Thermal Management of Batteries and Fuel Cells	PEC	3	0	0	3	3

**Details of Vertical II: PRODUCT AND PROCESS DEVELOPMENT**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5304	Value Engineering	PEC	3	0	0	3	3
2	22AU5305	Additive Manufacturing	PEC	3	0	0	3	3
3	22AU5306	CAD/CAM	PEC	3	0	0	3	3
4	22AU6303	Ergonomics in Design	PEC	3	0	0	3	3
5	22AU6304	New Product Development	PEC	3	0	0	3	3
6	22AU7302	Product Life Cycle Management	PEC	3	0	0	3	3

**Details of Vertical III: ROBOTICS AND AUTOMATION**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5307	Value Engineering	PEC	3	0	0	3	3
2	22AU5308	Additive Manufacturing	PEC	3	0	0	3	3
3	22AU5309	CAD/CAM	PEC	3	0	0	3	3
4	22AU6305	Ergonomics in Design	PEC	3	0	0	3	3
5	22AU6306	New Product Development	PEC	3	0	0	3	3
6	22AU7303	Product Life Cycle Management	PEC	3	0	0	3	3

**Details of Vertical IV: DIGITAL AND GREEN MANUFACTURING**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5310	Digital Manufacturing and IoT	PEC	3	0	0	3	3
2	22AU5311	Lean Manufacturing	PEC	3	0	0	3	3
3	22AU5312	Modern Robotics	PEC	3	0	0	3	3
4	22AU6307	Green Manufacturing Design and Practices	PEC	3	0	0	3	3
5	22AU6308	Environment Sustainability and Impact Assessment	PEC	3	0	0	3	3
6	22AU7304	Green Supply Chain Management	PEC	3	0	0	3	3

**Details of Vertical V: CLEAN AND GREEN ENERGY TECHNOLOGIES**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5313	Bioenergy Conversion Technologies	PEC	3	0	0	3	3
2	22AU5314	Carbon Footprint estimation and reduction techniques	PEC	3	0	0	3	3
3	22AU5315	Energy Conservation in Industries	PEC	3	0	0	3	3
4	22AU6309	Energy Efficient Buildings	PEC	3	0	0	3	3
5	22AU6310	Renewable Energy Technologies	PEC	3	0	0	3	3
6	22AU7305	Equipment for Pollution Control	PEC	3	0	0	3	3

**Details of Vertical VI: CORE ELECTIVE**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5316	Automotive Chassis	PEC	3	0	0	3	3
2	22AU5317	Automotive Transmission	PEC	3	0	0	3	3
3	22AU5318	Alternate Fuels and Energy Systems	PEC	3	0	0	3	3
4	22AU6311	Automotive Engine Components design	PEC	3	0	0	3	3
5	22AU6312	Finite Element Analysis	PEC	3	0	0	3	3
6	22AU7306	Automotive Pollution and Control	PEC	3	0	0	3	3

**Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

**Clause 4.10** of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

**VERTICALS FOR MINOR DEGREE**

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.  
Note: Each programme should provide verticals for minor degree

Minor Degree - Automotive Vehicle Technology (Offered by Automobile Engineering)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5601	Automotive Engines	3	0	0	3	40	60	100
2	22AU6601	Automotive Chassis	3	0	0	3	40	60	100
3	22AU6602	Automotive Transmission	3	0	0	3	40	60	100
4	22AU7601	Automotive Electronics	3	0	0	3	40	60	100
5	22AU7602	Intelligent vehicular systems	3	0	0	3	40	60	100
6	22AU8601	Electric and Hybrid vehicles	3	0	0	3	40	60	100

Minor Degree - Fintech and Block Chain (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CS5601	Financial Management	3	0	0	3	40	60	100
2	22CS5602	Fundamentals of Investment	3	0	0	3	40	60	100
3	22CS5603	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	22CS5604	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	22CS5605	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	22CS5606	Introduction to Fintech	3	0	0	3	40	60	100

Minor Degree - Entrepreneurship (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22BA5601	Foundation of Entrepreneurship	3	0	0	3	40	60	100
2	22BA6601	Introduction to Business Venture	3	0	0	3	40	60	100
3	22BA6602	Team Building & Leadership Management for Business	3	0	0	3	40	60	100
4	22BA7601	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100
5	22BA7602	Principles of Marketing Management for Business	3	0	0	3	40	60	100
6	22BA8601	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100

Minor Degree - Environment and Sustainability (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CEXXXX	Sustainable infrastructure Development	3	0	0	3	40	60	100
2	22CEXXXX	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
3	22CEXXXX	Sustainable Bio Materials	3	0	0	3	40	60	100
4	22CEXXXX	Materials for Energy Sustainability	3	0	0	3	40	60	100

5	22CEXXXX	Green Technology	3	0	0	3	40	60	100
6	22CEXXXX	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100

#### Honors Degree - Electric and hybrid vehicle development

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5204	Fundamentals of Electric and Hybrid Vehicles	3	0	0	3	40	60	100
2	22AU6204	Battery Technology	3	0	0	3	40	60	100
3	22AU6205	Automotive Embedded Systems	3	0	0	3	40	60	100
4	22AU7203	Advanced Automotive Safety Systems	3	0	0	3	40	60	100
5	22AU7204	Special Purpose Electric Vehicle	3	0	0	3	40	60	100
6	22AU8201	Electric Vehicles and its Sustainable Development	3	0	0	3	40	60	100

#### Honors Degree - Motorsport Engineering

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5205	Composite Structure	3	0	0	3	40	60	100
2	22AU6206	High performance engine design	3	0	0	3	40	60	100
3	22AU6207	Motorsports Electric Vehicle	3	0	0	3	40	60	100
4	22AU7205	Motorsports Vehicle Body Engineering	3	0	0	3	40	60	100
5	22AU7206	Motorsports Race Electronics and Control Systems	3	0	0	3	40	60	100
6	22AU8202	Motorsports racing circuits and Design	3	0	0	3	40	60	100

#### Honors Degree - Vehicle Development and Validation

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5206	Automotive Product Design and Development	3	0	0	3	40	60	100
2	22AU6208	Noise, Vibration and Harshness	3	0	0	3	40	60	100
3	22AU6209	Automotive Instrumentation	3	0	0	3	40	60	100
4	22AU7207	Testing and Measurement Systems	3	0	0	3	40	60	100
5	22AU7208	Homologation	3	0	0	3	40	60	100
6	22AU8203	Automotive Prototyping	3	0	0	3	40	60	100

### CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	24	21	24	20	10	165

\* Student can earn extra credit 35 over and above the total credits


ADDITIONAL CREDIT COURSE FOR NCC CADETS										
S.No	Course code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1	22HE1074	NCC General and National Integration	VA	1	0	0	1	100	0	100
2	22HE2074	Social Services and Community Development	VA	1	0	0	1	100	0	100
3	22HE3074	Leadership Qualities and Camp Activities	VA	1	0	0	1	100	0	100
4	22HE4074	General awareness, communication and Aero engines	VA	1	0	0	1	100	0	100

ADDITIONAL CREDIT COURSE FOR AUTOMOBILE ENGINEERING						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1	22VAAU01	Foundry Technology	VA	30 hrs	Internal	1
2	22VAAU02	Forming and Shaping of Plastics	VA	30 hrs	Internal	1
3	22VAAU03	Microcontroller Programming in Automotive applications	VA	30 hrs	Internal	1
4	22VAAU04	Vehicle development and testing regulations (ARAI)	VA	30 hrs	Internal	1
5	22VAAU05	Bigdata Analysis	VA	30 hrs	Internal	1
6	22VAAU06	Data mining	VA	30 hrs	Internal	1
7	22VAAU07	Fire and safety Engineering	VA	30 hrs	Internal	1
8	22VAAU08	Introduction to MS office	VA	30 hrs	Internal	1
9	22VAAU09	Advanced Automotive Electrical and Electronics	VA	30 hrs	Internal	1
10	222VAAU10	Autodesk Fusion 360	VA	30 hrs	Internal	1

**Note: Non Credit Course results will not consider for Award of Degree**

  
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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22MA1101	<b>MATRICES AND CALCULUS</b> (Common to all Branches)	3	1	0	4

The learner should be able to

- Course Objective**
1. Construct the characteristic polynomial of a matrix and use it to identify Eigen values and Eigenvectors
  2. Impart the knowledge of single variate calculus.
  3. Familiarize the student with functions of several variables.
  4. Acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
  5. Make a vector differential operator for vector function and theorems to solve engineering problems

Unit	Description	Instructional Hours
I	<b>Matrices</b> Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) - Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
II	<b>Single Variate Calculus</b> Rolle's Theorem – Lagrange's Mean Value Theorem - Maxima and Minima – Taylor's and Maclaurin's Series.	12
III	<b>Functions of Several Variables</b> Partial derivatives - Total derivative - Jacobians – Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.	12
IV	<b>Integral Calculus</b> Double integrals in Cartesian coordinates – Area enclosed by plane curves (excluding surface area) – Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates.	12
V	<b>Vector Calculus</b> Gradient, divergence and curl vectors - Green's theorem - Stoke's and Gauss divergence theorem (statement only) for cubes only.	12
<b>Total Instructional Hours</b>		<b>60</b>

At the end of the course, the learner will be able to

- Course Outcome**
- CO1: Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form.  
CO2: Apply the concept of differentiation to identify the maximum and minimum values of curve.  
CO3: Able to use differential calculus ideas on several variable functions.  
CO4: Apply multiple integral ideas in solving areas, volumes and other practical problems.  
CO5: Apply the concept of vector calculus in two and three-dimensional spaces.

**TEXT BOOKS:**

- T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10<sup>th</sup> edition, 2019.  
T2 - K. P. Uma and S. Padma, "Engineering Mathematics I (Matrices and Calculus)", Pearson Ltd, 2022.

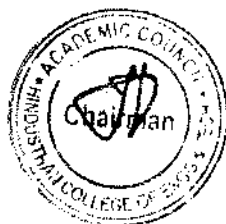
**REFERENCE BOOKS:**


- R1 - Jerrold E. Marsden, Anthony Tromba, "Vector Calculus", W.H. Freeman, 2003 - Strauss M. J, G. L Bradley and K. J Smith, "Multivariable calculus", 6<sup>th</sup> edition, Prentice Hall, 2011.  
R2 - Veerarajan T, "Engineering Mathematics", 5<sup>th</sup> edition, Mc Graw Hill Education(India) Pvt Ltd, New Delhi, 2016.  
R3 - G. B. Thomas and R. L. Finney, "Calculus and Analytical Geometry", 9<sup>th</sup> Edition, Addison Wesley Publishing Company, 2016.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	3	2	2	-	-	1	2	2	3	2
CO2	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO3	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO4	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO5	3	3	3	3	2	2	2	-	-	1	2	2	3	3
AVG	3	3	3	3	2.2	2	2			1	2	2	2.4	2.2

  
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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22ME1201	ENGINEERING DRAWING	1	2	0	3

**The learner should be able**

Course Objective

1. To gain the knowledge of Engineer's language of expressing complete details about objects and construction of conics and special curves.
2. To learn about the orthogonal projections of straight lines and planes.
3. To acquire the knowledge of projections of simple solid objects in plan and elevation.
4. To learn about the projection of sections of solids and development of surfaces.
5. To study the isometric projections of different objects.

Unit	Description	Instructional Hours
	<b>PLANE CURVES</b>	
I	Importance of engineering drawing; drafting instruments: drawing sheets – layout and folding; Lettering and dimensioning, BIS standards, scales. Geometrical constructions, Engineering Curves Conic sections – Construction of ellipse, parabola and hyperbola by eccentricity method. Construction of cycloids and involutes of square and circle – Drawing of tangents and normal to the above curves.	12
	<b>PROJECTIONS OF POINTS, LINES AND PLANE SURFACES</b>	
II	Introduction to Orthographic projections- Projection of points. Projection of straight lines inclined to both the planes, Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method (First angle projections only).	12
	<b>PROJECTIONS OF SOLIDS</b>	
III	Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular and inclined to one plane by rotating object method.	12
	<b>SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES</b>	
IV	Sectioning of simple solids with their axis 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. Development of lateral surfaces of truncated solids.	12
	<b>ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS</b>	
V	Isometric views and projections simple and truncated solids such as - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Free hand sketching of multiple views from a pictorial drawing. Basics of drafting using AutoCAD software.	12
	<b>Total Instructional Hours</b>	<b>60</b>

Course Outcome

- At the end of the course, the learner will be able to
- CO1: Understand and interpret the engineering drawings in order to visualize the objects and draw the conics and special curves.
- CO2: Draw the orthogonal projections of straight lines and planes.
- CO3: Interpret the projections of simple solid objects in plan and elevation.
- CO4: Draw the projections of section of solids and development of surfaces of solids.
- CO5: Draw the isometric projections and the perspective views of different objects.

**TEXT BOOK:**

- T1. K.Venugopal, V.Prabu Raja, "Engineering Drawing, AutoCAD, Building Drawings", 5th edition New Age International Publishers, New Delhi 2016.
- T2. K.V.Natarajan, "A textbook of Engineering Graphics", Dhanlaksmi Publishers, Chennai 2016.

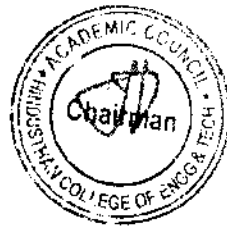
**REFERENCES:**


- R1. Basant Agrawal and C.M. Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing company Limited, New Delhi, 2013.
- R2. N.S. Parthasarathy, Vela Murali, "Engineering Drawing", Oxford University PRESS, India 2015.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	1	1	1	1	1	1	3	1	1	1	1
CO2	3	2	2	1	1	1	1	1	1	2	1	1	1	1
CO3	3	2	3	1	2	1	1	1	1	2	1	1	1	2
CO4	3	2	3	1	2	1	1	1	1	2	1	1	2	2
CO5	3	2	3	1	2	1	1	1	1	2	1	1	2	2
AVG	3	2	2.6	1	1.6	1	1	1	1	2.2	1	1	1.4	1.6

  
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Programme Semester	Course Code	Name of the Course	L	T	P	C
B.E. / I	22PH1153	<b>Physical properties of Materials</b> or B.E.AERO,AUTO,Mechanical& Mechatronics Engineering	2	0*	2	3

The learner should be able to :

- Course Objective
1. Have knowledge on the various phase diagrams of different materials and their applications
  2. Acquire knowledge on various crystal structures.
  3. Enhance the fundamental knowledge in mechanical properties of materials
  4. Gain knowledge about thermal energy and their applications
  5. Gain the knowledge on laser fundamentals and their applications

Unit	Description	Instructional Hours
	<b>PHASE DIAGRAMS</b>	
I	Solid solutions - Hume Rothery's rules - the phase rule – single component system – binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system – eutectic phase diagram - peritectic phase diagram.	6
	<b>CONDENSED MATTER PHYSICS</b>	
II	Crystalline and Amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, characteristics of unit cell – number of atoms per unit cell, coordination number, atomic radius and Packing factor for SC, BCC, FCC and HCP structures – Miller indices and interplanar spacing.	6
	<b>MECHANICAL PROPERTIES OF MATERIALS</b>	
III	Elasticity – Hooke's law – stress-strain diagram – bending moment – depression of a cantilever – Derivation of young's modulus of the material of the beam by uniform bending - theory and experiment. Twisting couple - Torsion pendulum: theory and experiment.	12
	<b>Determination of Young's modulus by uniform bending method</b> <b>Determination of Rigidity modulus – Torsion pendulum</b>	
	<b>THERMAL PHYSICS</b>	
IV	Transfer of heat energy – thermal conduction, convection and radiation – Thermal expansion - expansion joints - bimetallic strips – thermal conductivity of a bad conductor: Lee's disc method to determine the thermal conductivity of bad conductor. Conduction through compound media (series and parallel) – applications: refrigerator and solar water heater.	9
	<b>Determination of thermal conductivity of a bad conductor – Lee's disc method</b> <b>V – Lab - <a href="https://vlab.amrita.edu/?sub=1&amp;brch=194&amp;sim=353&amp;cnt=1">https://vlab.amrita.edu/?sub=1&amp;brch=194&amp;sim=353&amp;cnt=1</a></b>	
	<b>PHOTONICS</b>	
V	Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Type of lasers – Nd:YAG laser and CO <sub>2</sub> laser. Laser Applications - Industrial applications of laser. Interference - Conditions for sustained Interference – air wedge and its applications.	12
	<b>Determination of Wavelength and particle size using Laser</b> <b>Determination of thickness of a thin wire – Air wedge method</b> <b>V-Lab- <a href="https://vlab.amrita.edu/?sub=1&amp;brch=189&amp;sim=342&amp;cnt=1">https://vlab.amrita.edu/?sub=1&amp;brch=189&amp;sim=342&amp;cnt=1</a></b>	
	<b>Total Instructional Hours</b>	<b>45</b>

At the end of the course, the learner will be able to

- Course Outcome
- CO1: Develop the various phase diagrams of different materials
  - CO2: Relate the basics of crystals and their structures
  - CO3: Illustrate the mechanical properties of materials
  - CO4: Relate the thermal properties of materials and applications
  - CO5: Familiarize the concepts of optics in the field of Engineering

#### TEXTBOOKS:

- T1-Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2015.  
T2 - Gaur R.K. and Gupta S.L., Engineering Physics, 8<sup>th</sup> edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

#### REFERENCEBOOKS:

- R1-Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.  
R2 - William D.Callister Jr, David G. Rethwisch "Materials Science and Engineering - An Introduction", Wiley India (P) Ltd., 8th Edition, 2018.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	3	3	1	1	1	1	-	1	-	2	1	1	1
CO2	2	2	2	2	1	1	1	-	1	-	1	2	1	1
CO3	2	3	2	1	2	1	1	-	2	-	2	3	1	2
CO4	2	2	2	1	1	1	1	-	2	-	2	2	2	2
CO5	2	3	3	2	2	1	1	-	1	-	2	2	2	2
AVG	2	2.6	2.4	1.4	1.4	1	1	-	1.4	-	1.8	2.4	1.4	1.6

  
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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22HE1151	ENGLISH FOR ENGINEERS (Common to all Branches)	2	0	2	3

**The student should be able**

- Course Objective**
- To help the students of engineering and technology develop a strong base in the use of English.
  - To help learners use language effectively in professional writing.
  - To impart basic English grammar and essentials of important language skills
  - To impart knowledge about the importance of vocabulary and grammar
  - To develop the communication skills of the students in both formal and informal situations

Unit	Description	Instructional Hours
I	<b>Language Proficiency:</b> Parts of Speech, Degrees of Comparison, Abbreviation & Acronyms <b>Writing:</b> Process Description, Instructions. <b>Vocabulary</b> – Words on Environment. <b>Practical Component: Listening-</b> Watching Short Videos and answer the questions, <b>Speaking-</b> Self introduction, Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts / interviews <b>Reading-</b> Purpose of Reading - Churning & Assimilation, Interpreting Ideas - Interpreting Graphs in Technical Writing.	7+2
II	<b>Language Proficiency:</b> Types of Sentences, Framing Question. One Word Substitution <b>Writing:</b> Writing Checklist, Reading Comprehension. <b>Vocabulary</b> – Words on Entertainment. <b>Practical Component: Listening-</b> Comprehensions based on TED talks <b>Speaking-</b> Story Telling <b>Reading -</b> Skimming – Scanning – Reading: Scientific Texts	7+2
III	<b>Language Proficiency:</b> Tenses, Conditional Clause ('If' clause). Active and Passive voices. <b>Writing:</b> Formal letter (invitation, acceptance, decline, Congratulation) Cloze test. <b>Vocabulary</b> – Words on Tools. <b>Practical Component: Listening-</b> Listening pre-recorded English language learning programme <b>Speaking -</b> Just a minute <b>Reading-</b> Reading feature articles (from newspapers and magazines) -Reading to identify point of view and perspective (opinion pieces, editorials etc.)	5+4
IV	<b>Language Proficiency:</b> Subject Verb Concord, Articles, The Use of Prefixes and Suffixes <b>Writing:</b> Preparing Agenda & Minutes, Writing Recommendations. <b>Vocabulary</b> – Words on Engineering process. <b>Practical Component: Listening-</b> An interview with someone who works for recruitment personnel. <b>Speaking-</b> Presentation on a general topic. <b>Reading-</b> Reading Comprehension - Literary Texts.	5+4
V	<b>Language Proficiency:</b> Prepositions, Phrasal Verbs, Modal Auxiliaries, <b>Writing:</b> Letter to the Editor, Sequencing of Sentences <b>Vocabulary</b> – Words on Engineering material <b>Practical Component: Listening-</b> Listening- Comprehensions based on Nat Geo/Discovery channel videos <b>Speaking-</b> Preparing posters and presenting as a team. <b>Reading-</b> Biographies, Travelogues, Technical blogs.	6+3
<b>Total Instructional Hours</b>		<b>45</b>

**After completion of the course the learner will be able**

- Course Outcome**
- CO1: Understand English and converse effectively.
  - CO2: Enable the students to write coherently and cohesively.
  - CO3: Enable the development of basic grammar to enhance language for a better communication
  - CO4: use suitable vocabulary and grammar with confidence and express their ideas both in speech and writing.
  - CO5: follow the etiquettes in formal and informal communication.

**TEXT BOOKS:**

- T1- Raymond Murphy, "English Grammar in Use"-5<sup>th</sup> edition Cambridge University Press, 2019.  
T2-- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.

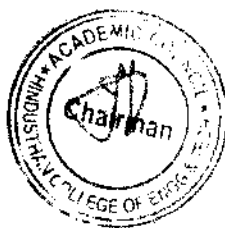
**REFERENCE BOOKS:**

- R1- Kapoor A.N., Business Letters for Different Occasions, New Delhi: S. Chand & Co. Pvt. Ltd., 2012.  
R2-Raymond Murphy, "English Grammar For ESL Learners - Premium Fourth Edition.  
R3- McCarthy, Michael et.al (2011) English Vocabulary in Use – advanced, Cambridge University Press.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	-	-	-	-	-	-	-	2	-	3	2	1	1	1
CO2	-	-	-	-	2	3	2	3	1	3	1	-	1	1
CO3	-	-	-	3	-	2	-	2	2	3	2	2	1	2
CO4	-	-	-	-	-	2	-	2	1	3	1	1	2	2
CO5	-	-	-	2	-	-	-	2	3	3	3	1	2	2
AVG	-	-	-	2.5	2	2.3	2	2.2	1.8	3	1.8	1.3	1.4	1.6

  
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**Course Objectives**

1. Understand automobile basics: components, classification, chassis layout, and drive types.
2. Grasp internal combustion engine fundamentals: types, ignition, cycles, and fuel systems.
3. Analyze transmission systems: clutches, gearboxes, and differential mechanisms.
4. Comprehend steering principles and brake types: mechanical, hydraulic, vacuum.
5. Gain insight into automotive electrical systems: batteries, alternators, lighting, and accessories.

**UNIT I INTRODUCTION**

(9)

Automobile - Components of an automobile - Classification of automobiles - Layout of chassis - Types of drives front wheel - rear wheel - four wheel.

**UNIT II IC ENGINES**

(9)

I.C. Engines - Classification - ignition system - firing order - Otto/ Diesel cycles - Two stroke and four stroke engines – scavenging - Cooling and Lubrication systems - Fuel Supply system – air fuel ratio.

**UNIT III TRANSMISSION SYSTEM**

(9)

Clutch - Function - single plate - multi plate - friction clutches - Centrifugal clutch - Gear Box - slide mesh - constant mesh and synchromesh gear box - Propeller shaft and rear axle - Universal joint – Differential - Rear axle drives - Wheels and Tyres.

**UNIT IV STEERING AND BRAKE**

(9)

Steering system - function and principle - steering and wheel geometry – steering gear boxes. Brakes - Mechanical - hydraulic and vacuum brake - master cylinder - wheel cylinder.

**UNIT V ELECTRICAL SYSTEMS**

(9)

Battery – types - Dynamo and Alternator – Cutout relay - Diagram of Wiring system - Lighting System and Accessories, Headlight - Lighting switches – Windscreen Wipers – Horn – Speedometer – Heater and Air conditioning.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Apply knowledge of automobile components and classifications to analyze vehicle structures and functionalities.
- CO2: Evaluate internal combustion engine systems, demonstrating an understanding of ignition, fuel cycles, and engine performance.
- CO3: Demonstrate proficiency in understanding and operating transmission systems, including clutches, gearboxes, and differential mechanisms.
- CO4: Implement steering principles and brake mechanisms effectively, ensuring safe and efficient vehicle control.
- CO5: Utilize understanding of automotive electrical systems to troubleshoot and maintain vehicle lighting, accessories, and electrical components.

**Text Books**

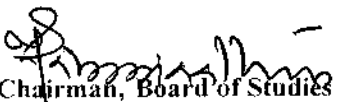
- T1 Kirpal Singh, Automotive Engineering, Vol. I & II, Standard Publishers, New Delhi, 2010.
- T2 Gupta, S K “A Textbook of Automobile Engineering”, Chand Publishing, 2013.

**References**

- R1 Rajput, R K, “A Textbook of Automobile Engineering”, Firewall Media, 2007.
- R1 Butterworth-Heinemann, “Automobile and Mechanical Electrical Systems”, Tom Denton Publisher, 2011.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	1	2	-	-	3	-	-	2	-	3	2	2
CO2	3	3	3	2	-	-	3	-	-	2	-	3	2	2
CO3	3	3	3	1	2	-	2	-	-	2	-	3	2	3
CO4	3	2	2	2	2	2	2	-	-	2	-	2	2	2
CO5	3	2	3	2	2	3	2	-	-	2	-	2	2	2
AVG	3	2.6	2.4	1.8	2	2.5	2.4	-	-	2	-	2.6	2	2.2

  
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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22HE1072	ENTREPRENEURSHIP AND INNOVATION (Common to all Branches)	1	0	0	1

The student should be made

**Course Objectives**

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement these plans.
5. To make students understand organizational performance and its importance.

**Module**

**Description**

- 1 Entrepreneurial Thinking
- 2 Innovation Management
- 3 Design Thinking
- 4 Opportunity Spotting / Opportunity Evaluation
- 5 Industry and Market Research
- 6 Innovation Strategy and Business Models
- 7 Financial Forecasting
- 8 Business Plans/ Business Model Canvas
- 9 Entrepreneurial Finance
- 10 Pitching to Resources Providers / Pitch Deck
- 11 Negotiating Deals
- 12 New Venture Creation
- 13 Lean Start-ups
- 14 Entrepreneurial Ecosystem
- 15 Velocity Venture

**TOTAL INSTRUCTIONAL HOURS**

**15**

**At the end of the course, the learner will be able to**

**Course Outcome**

- CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects.
- CO2: Understand the processes by which innovation is fostered, managed, and commercialized.
- CO3: Remember effectively and efficiently the potential of new business opportunities.
- CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness.
- CO5: Develop a business model for a new venture, including revenue, Margins, operations, Working capital, and investment

**TEXT BOOKS**

- T1: Arya Kumar "Entrepreneurship—Creating and leading an Entrepreneurial Organization", Pearson, Second Edition (2012).
- T2: Emrah Yayici "Design Thinking Methodology", Artbiztech, First Edition (2016).

**REFERENCE BOOKS**

- R1: Christopher Golis "Enterprise & Venture Capital", Allen & Unwin Publication, Fourth Edition (2007).
- R2: Thomas Lock Wood & Edger Papke "Innovation by Design", Career Press.com, Second Edition (2017).
- R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, First Edition (2010).

**WEB RESOURCES**

- W1: <https://blof.forgeforward.in/tagged/startup-lessons>
- W2: <https://blof.forgeforward.in/tagged/entrepreneurship>
- W3: <https://blof.forgeforward.in/tagged/minimum-viable-product>
- W4: <https://blof.forgeforward.in/tagged/minimum-viable-product>
- W5: <https://blof.forgeforward.in/tagged/innovation>

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	2
AVG	3	3	3	2.6	2.8	-	-	-	-	-	-	2	2	2.2

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Programme/  
Semester

Course Code

Course Title

L T P C


- Course Objectives:**
1. To develop and nurture the soft skills of the students through instruction, knowledge acquisition, demonstration and practice.
  2. To enhance the students ability to deal with numerical and quantitative skills.
  3. To identify the core skills associated with critical thinking.
  4. To develop and integrate the use of English language skills.

Unit	Description	Instructional Hours
I	<b>Lessons on excellence</b> Skill introspection, Skill acquisition, consistent practice	2
II	<b>Logical Reasoning</b> Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	11
III	<b>Quantitative Aptitude</b> Addition and Subtraction of bigger numbers - Square and square roots - Cubes and cube roots - Vedic maths techniques - Multiplication Shortcuts - Multiplication of 3 and higher digit numbers – Simplifications - Comparing fractions - Shortcuts to find HCF and LCM - Divisibility tests shortcuts - Algebra and functions	14
IV	<b>Recruitment Essentials</b> Resume Building - Impression Management	2
V	<b>Verbal Ability</b> Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement – Punctuations	4
<b>Total Instructional Hours</b>		<b>30</b>

<b>Course Outcome</b>	CO1	Students will analyze interpersonal communication skills. public speaking skills.
	CO2	Students will exemplify tautology, contradiction and contingency by logical thinking.
	CO3	Students will be able to develop an appropriate integral form to solve all sorts of quantitative problems.
	CO4	Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity.
	CO5	Students will be developed to acquire the ability to use English language with an error while making optimum use of grammar.

  
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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22MC1094	<b>HERITAGE OF TAMIL</b> (Common to all Branches)	2	0	0	1

The learner should be able to

- Course Objective
1. Introduce students to the great History of Tamil literature.
  2. Establish the heritage of various forms of Rock art and Sculpture art.
  3. To study and understand the various folk and Martial arts of Tamil culture
  4. Introduce students to Ancient Tamil concepts to understand the richness of Tamil literature.
  5. To learn about the various influences or impacts of Tamil language in Indian culture.

Unit	Description	Instructional Hours
I	<b>Language and Literature</b> Language families in India – Dravidian Languages – Tamil as a classical language – Classical Literature in Tamil- Secular nature of Sangam Literature – Distributive justice in Sangam Literature – Management principles in Thirukural – Tamil epics and impacts of Buddhism & Jainism in Tamil and Bakthi literature of Azhwars and Nayannars – Forms of minor poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidasan.	6
II	<b>Heritage _ Rock Art Paintings to Modern Art – Sculpture</b> Hero Stone to Modern Sculpture – Bronze icons – Tribes and their handicrafts - Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar statue at Kanyakumari, Making of musical instruments – Mridangam, Parai, Yazh and Nadhaswaram - Role of Temples in social and economic life of Tamils.	6
III	<b>Folk and Martial Arts</b> Therukoothu, Karagattam, Villupattu, Kaniyankoothu, Oyilattam, Leather puppetry, Silambattam..Valari Tiger dance – Sports and Games of Tamils.	6
IV	<b>Thinai Concept of Tamils</b> Flora and Fauna of Tamils – Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram concept of Tamils – Education and Literacy during Sangam Age - Ancient cities and ports of Sangam age – Export and Import during Sangam age – Overseas conquest of Cholas.	6
V	<b>Contribution of Tamils to Indian National Movement and Indian Culture</b> Contribution of Tamils to Indian freedom struggle – The cultural influence of Tamils over the other parts of India – Self respect movement – Role of Siddha Medicine in indigenous systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil books.	6
<b>Total Instructional Hours</b>		<b>30</b>

At the end of the course, the learner will be able to

- Course Outcome
- CO1: Learn about the works pertaining to Sangam age  
CO2: Aware of our Heritage in art from Stone sculpture to Modern Sculpture.  
CO3: Appreciate the role of Folk arts in preserving, sustaining and evolution of Tamil culture.  
CO4: Appreciate the intricacies of Tamil literature that had existed in the past.  
CO5: Understand the contribution of Tamil Literature to Indian Culture

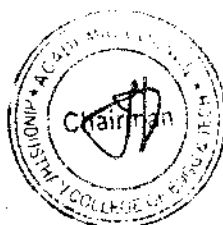
#### TEXT BOOKS:

- T1- Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)  
T2- Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by International Institute of Tamil Studies.  
T3- Historical Heritage of the Tamils (Dr.S.V.Subatamian, Dr.K.D. Thirunavukkarasu)(Published by International Institute of Tamil Studies).

#### REFERENCE BOOKS:

- R1-The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by International Institute of Tamil Studies)  
R2- Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu TextBook and Educational Services Corporation, Tamil Nadu)  
R3-Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

  
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Programme/ sem	Course Code	Name of the Course	L	T	P	C
B.E/B.Tech	22MC1093	தமிழர்மரபு	2	0	0	1
Unit	Description					Instructional Hours
I	<p><b>அலகு I மொழி மற்றும் இலக்கியம்:</b> 3</p> <p>இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.</p>					3
II	<p><b>அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை:</b> 3</p> <p>நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - கடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளூர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.</p>					3
III	<p><b>அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:</b> 3</p> <p>தெருக்கூத்து, கரகாட்டம், விலங்குப்பாட்டு, கணியான கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.</p>					3
IV	<p><b>அலகு IV தமிழர்களின் இணைக் கோட்பாடுகள்:</b> 3</p> <p>தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.</p>					3
V	<p><b>அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:</b> 3</p> <p>இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிக்கள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.</p>					3
Total Instructional Hours						15

## TEXT CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K Piliay) A joint publication of TNTB & ESC and RMRL - (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S Singaravelu) (Published by International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by International Institute of Tamil Studies.)
9. Keeladi - Sangam City Civilization on the banks of river Vaigai (Jointly Published by Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech /I	22MC1095	UNIVERSAL HUMAN VALUES (COMMON TO ALL BRANCHES)	2	0	0	0

**The student should be made**

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

**Course Objectives**

Unit	Description	Instructional Hours
I	<b>Introduction to Value Education</b> Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)-Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations	6
II	<b>Harmony in the Human Being and Harmony in the Family</b> Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self- Harmony of the Self with the Body - Programme to ensure self-regulation and Health	6
III	<b>Harmony in the Family and Society</b> Harmony in the Family – the Basic Unit of Human Interaction. Values in Human to Human Relationship 'Trust' – the Foundational Value in Relationship Values in Human to Human Relationship 'Respect' – as the Right Evaluation Understanding Harmony in the Society	6
IV	<b>Harmony in the Nature / Existence</b> Understanding Harmony in the Nature. Inter connectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature- Understanding Existence as Co-existence of mutually interacting units in all pervasivespace Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence. Vision for the Universal Human Order	6
V	<b>Implications of the Holistic Understanding – a Look at Professional Ethics</b> Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies Strategies for Transition towards Value-based Life and Profession	6
<b>Total Instructional Hours</b>		<b>30</b>

At the end of the course, the learner will be able

CO1: To become more aware of holistic vision of life - themselves and their surroundings.

CO2: To become more responsible in life, in the Society and in handling problems with sustainable Solutions.

Course Outcome CO3: To sensitive towards their commitment towards what they understood towards environment and Socially responsible behavior.

CO4: To able to apply what have learnt to their own self in different day-to-day settings in real life and in handling problems with sustainable solutions.

CO5: To develop competence and capabilities for maintaining Health and Hygiene.

**Reference Books:**

R1- A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

R2- Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-53-2

R3- Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

R4- Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
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CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2
AVG	2	3	3	-	2	-	-	-	2	-	-	2	2	2.2

  
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**Chairman - BoS**  
**AUTO - HICET**

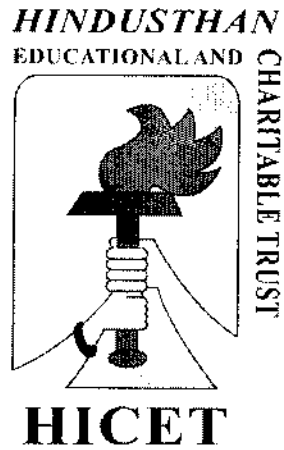


  
 Dean - Academics  
**Dean (Academics)**  
**HICET**



*HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY*  
(An Autonomous Institution Affiliated to Anna University, Chennai),  
(Approved by AICTE, New Delhi, Accredited by NAAC with 'A' Grade)  
Coimbatore - 641 032.

**B.E. AUTOMOBILE ENGINEERING**



**CHOICE BASED CREDIT SYSTEM**

**Curriculum under R2022**  
**(for the batch admitted during 2023 – 2024)**



**DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS**

**CBCS PATTERN**

**UNDERGRADUATE PROGRAMMES**

**B.E. AUTOMOBILE ENGINEERING (UG)**

**REGULATION-2022**

(For the students admitted during the academic year 2023-2024)

**SEMESTER I**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2.	22ME1201	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
3.	22PH1151	Physics for Non-Circuit Engineering	BSC	2	0	2	3	4	50	50	100
4.	22HE1151	English for Engineers	HSC	2	0	2	3	4	50	50	100
5.	22IT1151	Python Programming and Practices	ESC	2	0	2	3	4	50	50	100
<b>EEC COURSES (SE/AE)</b>											
6.	22HE1071	UHV	AEC	2	0	0	0	3	40	60	100
7.	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSE</b>											
8.	22MC1091/ 22MC1092	தமிழரும் தொழில் நுட்பமும் / Indian Constitution	MC	2	0	0	1	2	0	0	0
<b>TOTAL</b>				<b>15</b>	<b>5</b>	<b>6</b>	<b>18</b>	<b>27</b>	<b>370</b>	<b>330</b>	<b>700</b>

**SEMESTER II**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA2101	Differential equations and complex analysis	BSC	3	1	0	4	4	40	60	100
2.	22CY2101	Environmental Studies	ESC	2	0	0	2	3	40	60	100
3.	22PH2101	Basics of Material Science	BSC	2	0	0	2	3	40	60	100



4.	22ME2101	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5.	22CY2152	Applied Chemistry	BSC	2	0	2	3	4	50	50	100
6.	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
7.	22ME2001	Engineering Practices	ESC	0	0	4	2	2	50	50	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE2071	Design Thinking	AEC	2	0	0	2	2	100	0	100
9.	22HE2072	Soft Skills - I	AEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSE</b>											
10.	22MC2091/ 22MC2092	குமிழர் மரபு / Heritage of Tamils	MC	2	0	0	1	2	100	0	100
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
<b>TOTAL</b>				<b>19</b>	<b>2</b>	<b>12</b>	<b>23</b>	<b>28</b>	<b>610</b>	<b>390</b>	<b>1000</b>

### SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA3104	Fourier analysis and numerical techniques	BSC	3	1	0	4	4	40	60	100
2.	22AU3201	Fundamentals of Automotive Engines	PCC	3	0	0	3	3	40	60	100
3.	22AU3202	Fundamentals of Thermodynamics	PCC	3	1	0	4	3	40	60	100
4.	22AU3203	Mechanics of Materials	PCC	3	1	0	4	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5.	22AU3251	Manufacturing Technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
6.	22AU3001	Automotive Components Lab	ESC	0	0	4	2	4	60	40	100
7.	22AU3002	Mechanics of Materials Lab	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE3071	Soft Skills and Aptitude -II	SEC	1	0	0	1	1	100	0	100
9.	22AU3072	Machine Drawing	AEC	0	0	4	2	2	60	40	100
10.	22MC3191	Essence of Indian Traditional Knowledge	AEC	2	0	0	0	0	-	-	-
<b>TOTAL</b>				<b>19</b>	<b>3</b>	<b>10</b>	<b>25</b>	<b>29</b>	<b>470</b>	<b>430</b>	<b>900</b>



**SEMESTER IV**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2.	22AU4201	Automotive Chassis components Design	BSC	3	1	0	4	4	40	60	100
3.	22AU4202	Automotive Electricals and Electronics systems	PCC	3	0	0	3	3	40	60	100
4.	22AU4203	Mechanics of Machines	PCC	3	1	0	4	4	40	60	100
5.	22AU4204	Fluid Mechanics and Actuating Systems	PCC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU4251	Fundamentals of Heat Transfer	PCC	3	0	2	3	4	40	60	100
<b>PRACTICAL</b>											
7.	22AU4001	Automotive Electricals and Electronics Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU4002	Computer Aided Engine components design Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE4071	Soft Skills -III	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>2</b>	<b>10</b>	<b>24</b>	<b>29</b>	<b>460</b>	<b>440</b>	<b>900</b>
<p>* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same will be evaluated in Semester IV.                      If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed with Internship II (Total: 4 weeks-2 credits)</p>											

**SEMESTER V**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU5201	Vehicle design and data characteristics	PCC	3	0	0	3	4	40	60	100
2.	22AU5202	Automotive Fuels and Lubricants	PCC	3	0	0	3	3	40	60	100
3.	22AU53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	22AU53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	22AU53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU5251	Two and Three-wheeler technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
7.	22AU5001	Automotive Fuels and Lubricants Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>6</b>	<b>21</b>	<b>25</b>	<b>410</b>	<b>390</b>	<b>800</b>



### SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU6201	Vehicle Dynamics	PCC	3	0	0	3	3	40	60	100
2.	22HE6101	Professional Ethics (Common)	HSC	3	0	0	3	3	40	60	100
3.	22AU63XX	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4.	22AU63XX	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5.	22XX64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6.	22XX64XX	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
7.	22AU6001	Computer Aided Engineering Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU6002	Engine Performance and Emission testing laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE6071	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
<b>TOTAL</b>				<b>20</b>	<b>0</b>	<b>8</b>	<b>24</b>	<b>28</b>	<b>460</b>	<b>440</b>	<b>900</b>

### SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU7201	Design of Automotive Transmission systems	PCC	3	0	0	3	3	40	60	100
2.	22AU7202	Engine and Vehicle Management systems	PCC	3	1	0	4	4	40	60	100
3.	22AU73XX	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
4.	22XX7401	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5.	22LS74XX	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
6.	22AU7001	Vehicle Maintenance Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
7.	22AU7701	Internship - II'	SEC	-	-	-	2	1	100	0	100
<b>TOTAL</b>				<b>15</b>	<b>1</b>	<b>4</b>	<b>20</b>	<b>21</b>	<b>360</b>	<b>340</b>	<b>700</b>
* - Two weeks internship carries 1 credit and it will be done during Semester VI summer vacation/placement training and same will be evaluated in Semester VII.											

**SEMESTER VIII**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CA	ESE	Total
<b>EEC COURSES (SE/AE)</b>											
<b>I.</b>	<b>22AU8901</b>	Project Work/Granted Patent	SEC9	0	0	20	10	20	100	100	200
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>	<b>20</b>	<b>100</b>	<b>100</b>	<b>200</b>

Note:

- \*As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
- NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
- The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22.

**SEMESTER-WISE CREDIT DISTRIBUTION**

<b>B.E. / B.TECH. PROGRAMMES</b>										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	-	-	-	-	-	20
3	ESC	6	7	2	-	-	-	-	-	15
4	PCC	-	-	16	20	12	7	9	-	64
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	6	6	-	12
7	EEC	1	3	3	1	1	2	2	10	25
8	MCC	1	1	-	-	-	-	-	-	-
<b>Total</b>		<b>18</b>	<b>23</b>	<b>25</b>	<b>23</b>	<b>22</b>	<b>24</b>	<b>20</b>	<b>10</b>	<b>165</b>

**OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)**

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3
4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

### OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Biorefinery	OEC	3	0	0	3	3

**Note:** Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

### OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU7401	Automotive Fault diagnosis systems	OEC	3	0	0	3	3

### OPEN ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3

5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1 Modern Mobility Systems	Vertical 2 Product and Process Development	Vertical 3 Robotics and Automation	Vertical 4 Digital and Green Manufacturing	Vertical 5 Clean and Green Energy Technologies	Vertical 6 Core Elective
22AU5301 Automotive Materials, Design and Testing	22AU5304 Value Engineering	22AU5307 Sensors and Instrumentation	22AU5310 Digital Manufacturing and IoT	22AU5313 Bioenergy Conversion Technologies	22AU5316 Automotive Chassis
22AU5302 Futuristic Vehicle Technology	22AU5305 Additive Manufacturing	22AU5308 Electrical Drives and Actuators	22AU5311 Lean Manufacturing	22AU5314 Solar Thermal Technology	22AU5317 Automotive Transmission
22AU5303 Renewable Energy and Emission Control Technology for Off Road Vehicles	22AU5306 CAD/CAM	22AU5309 Embedded Systems and Programming	22AU5312 Modern Robotics	22AU5315 Energy Conservation in Industries	22AU5318 Alternate Fuels and Energy Systems
22AU6301 Vehicle Health Monitoring, Maintenance and Safety	22AU6303 Ergonomics in Design	22AU6305 Robotics	22AU6307 Green Manufacturing Design and Practices	22AU6309 Energy Efficient Buildings	22AU6311 Automotive Engine Components design
22AU6302 Hybrid and Electric Vehicle Technology	22AU6304 New Product Development	22AU6306 Smart Mobility and Intelligent Vehicles	22AU6308 Environment Sustainability and Impact Assessment	22AU6310 Renewable Energy Technologies	22AU6312 Finite Element Analysis
22AU7301 Thermal Management of Batteries and Fuel Cells	22AU7302 Product Life Cycle Management	22AU7303 Haptics and Immersive Technologies	22AU7304 Green Supply Chain Management	22AU7305 Equipment for Pollution Control	22AU7306 Automotive Pollution and Control

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

#### Details of Vertical I: MODERN MOBILITY SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATEG ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5301	Automotive Materials, Design and Testing	PEC	3	0	0	3	3
2	22AU5302	Futuristic Vehicle Technology	PEC	3	0	0	3	3
3	22AU5303	Renewable Energy and Emission Control Technology for Off Road Vehicles	PEC	3	0	0	3	3

4	22AU6301	Vehicle Health Monitoring, Maintenance and Safety	PEC	3	0	0	3	3
5	22AU6302	Hybrid and Electric Vehicle Technology	PEC	3	0	0	3	3
6	22AU7301	Thermal Management of Batteries and Fuel Cells	PEC	3	0	0	3	3

**Details of Vertical II: PRODUCT AND PROCESS DEVELOPMENT**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5304	Value Engineering	PEC	3	0	0	3	3
2	22AU5305	Additive Manufacturing	PEC	3	0	0	3	3
3	22AU5306	CAD/CAM	PEC	3	0	0	3	3
4	22AU6303	Ergonomics in Design	PEC	3	0	0	3	3
5	22AU6304	New Product Development	PEC	3	0	0	3	3
6	22AU7302	Product Life Cycle Management	PEC	3	0	0	3	3

**Details of Vertical III: ROBOTICS AND AUTOMATION**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5307	Sensors and Instrumentation	PEC	3	0	0	3	3
2	22AU5308	Electrical Drives and Actuators	PEC	3	0	0	3	3
3	22AU5309	Embedded Systems and Programming	PEC	3	0	0	3	3
4	22AU6305	Robotics	PEC	3	0	0	3	3
5	22AU6306	Smart Mobility and Intelligent Vehicles	PEC	3	0	0	3	3
6	22AU7303	Haptics and Immersive Technologies	PEC	3	0	0	3	3

**Details of Vertical IV: DIGITAL AND GREEN MANUFACTURING**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5310	Digital Manufacturing and IoT	PEC	3	0	0	3	3
2	22AU5311	Lean Manufacturing	PEC	3	0	0	3	3
3	22AU5312	Modern Robotics	PEC	3	0	0	3	3
4	22AU6307	Green Manufacturing Design and Practices	PEC	3	0	0	3	3
5	22AU6308	Environment Sustainability and Impact Assessment	PEC	3	0	0	3	3
6	22AU7304	Green Supply Chain Management	PEC	3	0	0	3	3

**Details of Vertical V: CLEAN AND GREEN ENERGY TECHNOLOGIES**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5313	Bioenergy Conversion Technologies	PEC	3	0	0	3	3
2	22AU5314	Solar Thermal Technology	PEC	3	0	0	3	3
3	22AU5315	Energy Conservation in Industries	PEC	3	0	0	3	3
4	22AU6309	Energy Efficient Buildings	PEC	3	0	0	3	3
5	22AU6310	Renewable Energy Technologies	PEC	3	0	0	3	3
6	22AU7305	Equipment for Pollution Control	PEC	3	0	0	3	3

**Details of Vertical VI: CORE ELECTIVE**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5316	Automotive Chassis	PEC	3	0	0	3	3
2	22AU5317	Automotive Transmission	PEC	3	0	0	3	3
3	22AU5318	Alternate Fuels and Energy Systems	PEC	3	0	0	3	3
4	22AU6311	Automotive Engine Components design	PEC	3	0	0	3	3
5	22AU6312	Finite Element Analysis	PEC	3	0	0	3	3
6	22AU7306	Automotive Pollution and Control	PEC	3	0	0	3	3

**Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

**Clause 4.10** of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

**VERTICALS FOR MINOR DEGREE**

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

Note: Each programme should provide verticals for minor degree

<b>Minor Degree - Automotive Vehicle Technology (Offered by Automobile Engineering )</b>									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5601	Automotive Engines	3	0	0	3	40	60	100
2	22AU6601	Automotive Chassis	3	0	0	3	40	60	100

3	22AU6602	Automotive Transmission	3	0	0	3	40	60	100
4	22AU7601	Automotive Electronics	3	0	0	3	40	60	100
5	22AU7602	Intelligent vehicular systems	3	0	0	3	40	60	100
6	22AU8601	Electric and Hybrid vehicles	3	0	0	3	40	60	100

**Minor Degree - Fintech and Block Chain (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CS5601	Financial Management	3	0	0	3	40	60	100
2	22CS5602	Fundamentals of Investment	3	0	0	3	40	60	100
3	22CS5603	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	22CS5604	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	22CS5605	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	22CS5606	Introduction to Fintech	3	0	0	3	40	60	100

**Minor Degree - Entrepreneurship (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22BA5601	Foundation of Entrepreneurship	3	0	0	3	40	60	100
2	22BA6601	Introduction to Business Venture	3	0	0	3	40	60	100
3	22BA6602	Team Building & Leadership Management for Business	3	0	0	3	40	60	100
4	22BA7601	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100
5	22BA7602	Principles of Marketing Management for Business	3	0	0	3	40	60	100
6	22BA8601	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100

**Minor Degree - Environment and Sustainability (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CEXXXX	Sustainable infrastructure Development	3	0	0	3	40	60	100
2	22CEXXXX	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
3	22CEXXXX	Sustainable Bio Materials	3	0	0	3	40	60	100
4	22CEXXXX	Materials for Energy Sustainability	3	0	0	3	40	60	100
5	22CEXXXX	Green Technology	3	0	0	3	40	60	100
6	22CEXXXX	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100

**Honors Degree - Electric and hybrid vehicle development**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5203	Fundamentals of Electric and Hybrid Vehicles	3	0	0	3	40	60	100
2	22AU6202	Battery Technology	3	0	0	3	40	60	100

3	22AU6203	Automotive Embedded Systems	3	0	0	3	40	60	100
4	22AU7203	Advanced Automotive Safety Systems	3	0	0	3	40	60	100
5	22AU7204	Special Purpose Electric Vehicle	3	0	0	3	40	60	100
6	22AU8201	Electric Vehicles and its Sustainable Development	3	0	0	3	40	60	100
<b>Honors Degree - Motorsport Engineering</b>									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5204	Composite Structure	3	0	0	3	40	60	100
2	22AU6204	High performance engine design	3	0	0	3	40	60	100
3	22AU6205	Motorsports Electric Vehicle	3	0	0	3	40	60	100
4	22AU7205	Motorsports Vehicle Body Engineering	3	0	0	3	40	60	100
5	22AU7206	Motorsports Race Electronics and Control Systems	3	0	0	3	40	60	100
6	22AU8202	Motorsports racing circuits and Design	3	0	0	3	40	60	100
<b>Honors Degree - Vehicle Development and Validation</b>									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5205	Automotive Product Design and Development	3	0	0	3	40	60	100
2	22AU6206	Noise, Vibration and Harshness	3	0	0	3	40	60	100
3	22AU6207	Automotive Instrumentation	3	0	0	3	40	60	100
4	22AU7207	Testing and Measurement Systems	3	0	0	3	40	60	100
5	22AU7208	Homologation	3	0	0	3	40	60	100
6	22AU8203	Automotive Prototyping	3	0	0	3	40	60	100

### CREDIT DISTRIBUTION


Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	26	24	18	14	165

\* Student can earn extra credit 35 over and above the total credits

<b>ADDITIONAL CREDIT COURSE FOR NCC CADETS</b>										
S.No	Course code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1	22HE1074	NCC General and National Integration	VA	1	0	0	1	100	0	100
2	22HE2074	Social Services and Community Development	VA	1	0	0	1	100	0	100
3	22HE3074	Leadership Qualities and Camp Activities	VA	1	0	0	1	100	0	100
4	22HE4074	General awareness, communication and Aero engines	VA	1	0	0	1	100	0	100

ADDITIONAL CREDIT COURSE FOR AUTOMOBILE ENGINEERING						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1	22VAAU01	Foundry Technology	VA	30 hrs	Internal	1
2	22VAAU02	Forming and Shaping of Plastics	VA	30 hrs	Internal	1
3	22VAAU03	Microcontroller Programming in Automotive applications	VA	30 hrs	Internal	1
4	22VAAU04	Vehicle development and testing regulations (ARAI)	VA	30 hrs	Internal	1
5	22VAAU05	Bigdata Analysis	VA	30 hrs	Internal	1
6	22VAAU06	Data mining	VA	30 hrs	Internal	1
7	22VAAU07	Fire and safety Engineering	VA	30 hrs	Internal	1
8	22VAAU08	Introduction to MS office	VA	30 hrs	Internal	1
9	22VAAU09	Advanced Automotive Electrical and Electronics	VA	30 hrs	Internal	1
10	22VAAU10	Autodesk Fusion 360	VA	30 hrs	Internal	1

**Note: Non Credit Course results will not consider for Award of Degree**

  
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**PRINCIPAL**  
 Hindusthan College Of Engineering & Technology,  
 COIMBATORE - 641 032.

Programme	Course Code	Name of the Course	L	T	P	C
B.E	22MA3104	FOURIER ANALYSIS AND NUMERICAL TECHNIQUES	3	1	0	4

The learner should be able to

1. Analyze the Fourier series which is central to many applications in engineering.
2. Acquaint the knowledge of the effective tools for the solutions of one and two dimensional boundary value problems.
3. Explore the Fourier transform techniques in various situations.
4. Explain single and multi step methods to solve Ordinary differential equations
5. Describe various methods to solve ordinary differential equations and partial differential equations

Course Objective

Unit	Description	Instructional Hours
I	<b>FOURIER SERIES</b> Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Change of Interval - RMS Value - Parseval's Identity - Half Range Sine and Cosine Series - Harmonic analysis.	12
II	<b>BOUNDARY VALUE PROBLEMS</b> Classification of PDE - Problems based on one dimensional wave equation - One dimensional equation of heat conduction (excluding insulated edges) - Two dimensional heat equations - Steady state solution of two dimensional equation of heat conduction in infinite plate.	12
III	<b>FOURIER TRANSFORMS</b> Fourier Transform Pairs - Fourier Sine and Cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem (Statement only) – Parseval's identity (Statement only).	12
IV	<b>INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS</b> Single step methods for solving first order equations: Taylor's series method – Euler and Modified Euler methods – Fourth order Runge-kutta method - Multi step method: Milne's predictor and corrector method.	12
V	<b>BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS</b> Solution of second order ordinary differential equation by Finite difference method – Solution of partial differential equation: one dimensional heat equation by Bender schmidt method – One dimensional Wave equation by Explicit method – Laplace Equations and Poisson Equations.	12
<b>Total Instructional Hours</b>		<b>60</b>

At the end of the course, the learner will be able to

- Course Outcome
- CO1: Apply the principles of Fourier series which helps them to solve physical problems of engineering.  
CO2: Employ Fourier series in solving the boundary value problems.  
CO3: Apply Fourier transform techniques which extend its applications.  
CO4: Classify and solve ordinary differential equations by using single and multi step methods.  
CO5: find the solution of ordinary and partial differential equations.

TEXT BOOKS:

- T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10<sup>th</sup> Edition, Wiley India Private Ltd., New Delhi, 2023  
T2 - Bali. N.P and Manish Goyal & Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2015.

REFERENCE BOOKS:

- R1 - Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2012.  
R2 - Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2018.  
R3 - Grewal B.S. and Grewal J.S. " Numerical Methods in Engineering and Science ", 10<sup>th</sup> Edition, Khanna publishers, New Delhi 2015.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	3	1	1	-	-	1	2	2	3	2
CO2	3	3	3	3	3	1	1	-	-	1	2	2	3	2
CO3	3	3	3	3	2	1	1	-	-	1	2	2	3	2
CO4	3	3	3	2	2	1	2	-	-	1	2	2	2	2
CO5	3	3	3	2	2	1	2	-	-	1	3	2	2	2
AVG	3	3	3	2.6	2.4	1	1.4	-	-	1	2.2	2	2.6	2

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**AUTO - HICET**



*[Signature]*  
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**Course Objectives**

1. To develop a comprehensive understanding of IC engines, explore the thermodynamic cycles involved, and introduce the concept of hydrogen engines
2. To get comprehensive knowledge of various fuel injection and ignition systems used in IC engine
3. To understand the combustion phenomena and design considerations in SI engines.
4. To comprehend the combustion processes and design considerations in CI engines.
5. To identify the nature of pollutant formation and explore techniques for controlling emissions.

**UNIT I INTERNAL COMBUSTION ENGINES (9)**

Introduction: Construction and Working of Two-Stroke and Four-Stroke SI and CI Engines, Comparison of SI and CI Engines, Engine Classification and Firing Order, Otto Cycle, Diesel Cycle, and Dual Cycles, hydrogen engines.

**UNIT II INJECTION AND IGNITION SYSTEMS (9)**

Diesel Fuel Injection Systems: Types, Functions, Fuel Injection Pump, Jerk Distributor, Mechanical and Pneumatic Speed Governor, Fuel Injector: Types of Nozzle, Common Rail Direct Injection (CRDI), Air-Fuel Ratio: Carburetion, Types of Carburetor, Spark Plug: Ignition Systems, Battery Coil, Magneto Coil, Electronic Type, Petrol Injection System: Multi-Point Fuel Injection (MPFI), Gasoline Direct Injection (GDi).

**UNIT III COMBUSTION IN S.I. ENGINES (9)**

SI Engine Combustion: Combustion Chambers, Stages of Combustion, Knocking, Factors Affecting Flame Propagation, Detonation: Types of Injection in SI Engines, Flame Structure and Speed, Lean Burn Combustion, Stratified Charge Combustion Systems.

**UNIT IV COMBUSTION IN C.I. ENGINES (9)**

CI Engine Combustion: Fuel Spray Formation, Air Motion, Swirl Combustion, Stages of Combustion, Factors Affecting Ignition Delay and Knocking, Comparison of Knock in CI and SI Engines, Types of Injection in CI Engines, Types of Combustion Chambers.

**UNIT V ENGINE PERFORMANCE AND EMISSION STANDARDS (9)**

Indicated Power, Brake Power, Engine Torque, Mechanical Efficiency, Air Standard Efficiency, Emissions: Types (CO, HC, NO<sub>x</sub>, SO<sub>2</sub>), Emission Control Measures for IC Engines, Bharat Stage (BS) Standards and Norms, Effect of Emissions on the Environment and Human Beings.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Gain comprehensive understanding of IC engines, thermodynamic cycles, and hydrogen engines.
- CO2: Identify and categorize different types of injection and ignition systems.
- CO3: Attain in-depth knowledge of combustion phenomena in spark ignition (SI) engines.
- CO4: study of combustion in CI engines aimed to acquire an extensive understanding of the process.
- CO5: Utilize acquired knowledge to assess and manage pollution levels effectively.

**Text Books**

- T1 John B. Heywood, "Internal Combustion Engines", McGraw-Hill Book Company
- T2 M.L. Mathur and R.P. Sharma, Internal Combustion Engine, Dhanpath Rai Publications (P) Ltd, New Delhi
- T3 V. Ganesan, Internal Combustion Engines, Tata-McGraw Hill Publishing Co., New Delhi

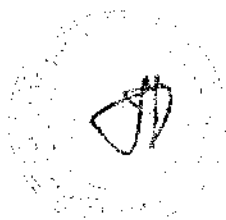
**References**

- R1 K. K. Ramalingam, internal Combustion Engines, Scitech publications, Chennai, 2018.
- R2 Heldt, P.M., High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	2	-	3	2	-	3	-	2	2	2
CO2	3	3	2	2	2	-	2	-	-	2	-	1	3	2
CO3	3	3	2	2	2	2	2	2	-	2	-	2	3	2
CO4	3	2	1	2	-	-	2	-	-	2	-	2	2	2
CO5	3	2	2	2	2	-	2	-	-	2	-	2	2	2
AVG	3	2.4	1.8	2.2	2	2	2.2	2	-	2.2	-	1.8	2.4	2

  
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**Course Objectives**

1. To understand and quantify the energy conversion.
2. To understand the energy degradation in thermodynamic systems.
3. To understand the behavior of pure substances and working principle of steam power cycles.
4. To understand the thermodynamic relations.
5. To understand the properties of atmospheric air and its applications.

(Use of Standard and approved Steam Tables, Mollier chart, Compressibility and Psychrometric Charts permitted)

**UNIT I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS****(9+3)**

Basic concepts - concept of continuum, microscopic and macroscopic approach, path and point functions. Intensive and extensive properties, thermodynamic system, equilibrium, state, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics—concept of temperature and thermal equilibrium. First Law of thermodynamics—application to closed and open systems.

**UNIT II SECOND LAW OF THERMODYNAMICS****(9+3)**

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle, Reversed Carnot cycle. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy Change for pure substance, ideal gases—different processes, principle of increase in entropy.

**UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE****(9+3)**

Formation of steam and its thermodynamic properties, P-v, P-T, T-v, T-s, h-s diagrams. P-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Steam power cycle. Ideal and actual Rankine cycles, Cycle Improvement Methods-Reheat and Regenerative cycles.

**UNIT IV IDEAL AND REAL GASES, GAS MIXTURES AND THERMODYNAMIC RELATIONS****(9+3)**

Properties of Ideal and real gases Equations of state, Vander Waals equation for ideal and real gases, reduced properties, Compressibility factor, Generalized Compressibility Chart and its use. Gas mixtures—mole and mass fractions, Dalton law, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation.

**UNIT V PSYCHROMETRY****(9+3)**

Psychrometric properties, Property calculations of air vapour mixtures using psychrometric chart and expressions. Psychrometric process: sensible heating and cooling, humidification, dehumidification, adiabatic saturation, adiabatic mixing of two streams.

**TOTAL: 60 PERIODS****Course Outcomes**

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

- CO1: Understand the thermodynamic principles and its applications.
- CO2: Quantify the energy conversion in various thermal systems.
- CO3: Identify the losses and inefficient components in the thermodynamic system.
- CO4: Apply the thermodynamic principles for predicting the properties of steam and gas mixtures.
- CO5: Apply the psychrometric principles for design of air conditioning systems.

**Text Books**

- T1 Nag.P.K., "Engineering Thermodynamics", 4<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2008.
- T2 Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.

**References**

- R1 K. K. Ramalingam, internal Combustion Engines, Scitech publications, Chennai, 2018.
- R2 Heldt, P.M., High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta
- R3 Holman.J.P., "Thermodynamics", 3rd Edition. McGraw-Hill, 1995.
- R4 Rathakrishnan.E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall of India Pvt.Ltd, 2006

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	2	-	3	2	-	3	-	2	2	2
CO2	3	3	2	2	2	-	2	-	-	2	-	1	3	2
CO3	3	3	2	2	2	2	2	2	-	2	-	2	3	2
CO4	3	2	1	2	-	-	2	-	-	2	-	2	2	2
CO5	3	2	2	2	2	-	2	-	-	2	-	2	2	2
AVG	3	2.4	1.8	2.2	2	2	2.2	2	-	2.2	-	1.8	2.4	2

  
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**Course Objectives**

1. To understand the concepts of stress, strain, principal stresses and principal planes.
2. To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
3. To determine stresses and deformation in circular shafts and helical spring due to torsion.
4. To compute slopes and deflections in determinate beams by various methods.
5. To study the stresses and deformations induced in thin and thick shells.

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS**

12

Stress – Strain – Types – Elasticity, Elastic laws and Elastic Constants – Factor of safety - Deformation of simple and compound bars – Thermal stresses – Volumetric strains.

**UNIT II LOADING AND STRESSES ON BEAMS**

12

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Flitched beams.

**UNIT III TORSION**

12

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, carriage springs.

**UNIT IV DEFLECTION OF BEAMS**

12

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

**UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS**

12

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells.

**TOTAL: 60 PERIODS****Course Outcomes**

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

- CO1: Understand the thermodynamic principles and its applications.
- CO2: Quantify the energy conversion in various thermal systems.
- CO3: Identify the losses and inefficient components in the thermodynamic system.
- CO4: Apply the thermodynamic principles for predicting the properties of steam and gas mixtures.
- CO5: Apply the psychrometric principles for design of air conditioning systems.

**Text Books**

- T1 Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
- T2 Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

**References**

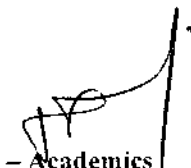
- R1 Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
- R2 Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002
- R3 Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	2	-	3	2	-	3	-	2	2	2
CO2	3	3	2	2	2	-	2	-	-	2	-	1	3	2
CO3	3	3	2	2	2	2	2	2	-	2	-	2	3	2
CO4	3	2	1	2	-	-	2	-	-	2	-	2	2	2
CO5	3	2	2	2	2	-	2	-	-	2	-	2	2	2
AVG	3	2.4	1.8	2.2	2	2	2.2	2	-	2.2	-	1.8	2.4	2

  
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**Course Objectives**

1. To understand the manufacturing concepts of metal casting processes
2. To develop the knowledge in metal joining process
3. To acquire knowledge about various machining processes
4. To interpret the students about forming of plastics and metals
5. To get knowledge of powder metallurgy used in automobile applications

**UNIT I METAL CASTING PROCESSES****(9)**

Sand Casting – Sand Moulds- Type of Patterns – Pattern Materials – Pattern Allowances – Types of Moulding Sand – Properties – Core Making – Methods of Sand Testing – Working Principle of Special Casting Processes – Shell-Pressure Die Casting – Centrifugal Casting – CO<sub>2</sub> Process – Sand Casting Defects – Inspection Methods  
Preparation of Sand Mould With Solid & Split Pattern.

**UNIT II JOINING PROCESSES****(9)**

Fusion Welding Processes – Types of Gas Welding – Equipments Used – Flame Characteristics – Filler and Flux Materials - Arc Welding Equipments - Gas Metal Arc Welding – Flux Cored – Submerged Arc Welding – Electro Slag Welding – TIG and MIG Welding Process. Principles Of Resistance Welding – Spot/Butt, Seam Welding – Percussion Welding- Weld Defects.

Experimental procedure of Butt joint, T joint, L joint using Arc Welding Equipments

**UNIT III MACHINING PROCESSES****(9)**

Construction, Working Principles And Commonly Performed Operations In The Following Machines: Lathe -Shaper- Mechanisms-Planer-Types-Milling Machine-Types-Drilling Machine-Types-Grinding Machine-Types-Basics Of CNC Machines.

Experimental Procedure of Facing, Plain Turning and Step Turning

**UNIT IV MANUFACTURING OF PLASTIC COMPONENTS****(9)**

Types of Plastics - Characteristics of the Forming and Shaping Processes – Moulding of Thermoplastics – Working Principles and Typical Applications - Injection Moulding – Blow Moulding – Rotational Moulding – Film Blowing – Extrusion – Thermoforming.

Industrial / Field visit to Plastic Components Manufacturing Industries

**UNIT V METAL DEFORMATION AND POWDER METALLURGY****(9)**

Principles of Extrusion – Types of Extrusion – Hot and Cold Extrusion. Sheet Metal Characteristics - Typical Shearing Operations, Bending and Drawing Operations – Stretch Forming Operations - Metal Spinning. Powder Metallurgy Process – Sintering Process Variables, Manufacture of Friction Lining Materials for Clutches and Brakes – Plastics - Raw Material – Automobile Components

Experimental Procedure of Cylindrical Grinding, Surface Grinding

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Students will be able to get in-depth knowledge of various manufacturing processes  
 CO2: Students will get in depth knowledge about metal joining and metal removing process  
 CO3: Students can have capable to select appropriate manufacturing process for a particular Engineering application and their projects.  
 CO4: Capable of students to do basic manufacturing process  
 CO5: learnt about advance powder metallurgy and manufacturing process

**Text Books**

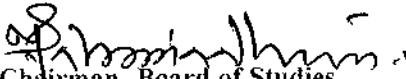
- T1 Hajra Choudhury, “Elements of Workshop Technology”, Vol-I and Vol-II Asia Publishing House, 1996.  
 T2 R.K.Jain and S.C.Gupta, “Production Technology”, Hanna Publishers, 1997.  
 T3 P.C. Sharma, “A text book of production technology”, S. Chand and Company, IV Edition, 2003.  
 T4 Serope Kalpakjian, and Steven R. Schmid, “Manufacturing Engineering and Technology”, Pearson Education.

**References**

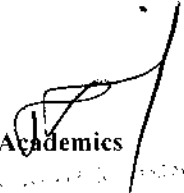
- R1 Ghosh, A., and Malik, A. K., “Manufacturing Science”, Affiliated East west Press Pvt. Ltd., 2008.  
 R2 Rao PN, “Manufacturing Technology”, 3/e, TMH, New Delhi, 2010.  
 R3 H.M.T. “Production Technology-Hand Book, Tata McGraw Hill, 1990.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	2	-	3	2	-	3	-	2	2	2
CO2	3	3	2	2	2	-	2	-	-	2	-	1	3	2
CO3	3	3	2	2	2	2	2	2	-	2	-	2	3	2
CO4	3	2	1	2	-	-	2	-	-	2	-	2	2	2
CO5	3	2	2	2	2	-	2	-	-	2	-	2	2	2
AVG	3	2.4	1.8	2.2	2	2	2.2	2	-	2.2	-	1.8	2.4	2

  
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**Course Objectives**

1. To gain knowledge of the operational principles of petrol and diesel engines.
2. To acquire knowledge about fuel supply system and vehicles frames.
3. To examine and analyze the construction and operation of vehicle axles and differentials.
4. To comprehend the operation and purpose of the clutch and gearbox.
5. To comprehend the operation of the steering system as well as the cooling and lubrication system.

**LIST OF EXPERIMENTS**

1. Dismantle and assemble a multi-cylinder petrol engine to identify its nomenclature.
2. Disassemble, examine the nomenclature, and reassemble a multi-cylinder diesel engine.
3. Examine the fuel systems of petrol and diesel engines.
4. Analyze and measure the frames of light and heavy commercial vehicles.
5. Axle Dismantling and Assembly: Front and Rear Axles
6. Disassemble and assemble differentials and to identify the load distribution.
7. Dismantling and Assembly of a Clutch.
8. Analysis of Gearbox Functioning and Components to Compute Gear Ratios.
9. Investigate the functioning of steering systems.
10. Explore the cooling and lubrication systems.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Acquire knowledge about the functioning principles of petrol and diesel engines.  
 CO2: Obtain a comprehensive understanding of the fuel supply system and vehicle frames.  
 CO3: Evaluate and analyze the design and functionality of vehicle axles and differentials  
 CO4: Gain knowledge about the working mechanisms and functions of the clutch and gearbox.  
 CO5: Gain an understanding of the purpose and operation of the steering system and the cooling and lubrication system.

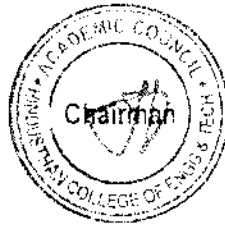
**LIST OF EQUIPMENTS**

S.No.	NAME OF THE EQUIPMENTS	QTY
1	Multi Cylinder Petrol Engine	2
2	Multi Cylinder Diesel Engine	2
3	Petrol and Diesel Fuel System Each	2
4	Heavy Duty Vehicle Chassis Frame	1
5	Light Duty Vehicle Chassis Frame	1
6	Front Axle	2
7	Rear Axle	2
8	Differential	2
9	Clutch and Gear Box (Light & Heavy Duty) Each	2
10	Steering Systems with different Gear Boxes	Each 1

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12*	PSO-1	PSO-2
CO1	3	2	2	3	2	-	3	2	-	3	-	2	3	2
CO2	3	3	2	2	2	-	2	-	-	2	-	1	3	2
CO3	3	3	2	2	2	2	2	2	-	2	-	2	3	2
CO4	3	2	1	2	-	-	2	-	-	2	-	2	3	2
CO5	3	2	2	2	2	-	2	-	-	2	-	2	3	2
AVG	3	2.4	1.8	2.2	2	2	2.2	2	-	2.2	-	1.8	3	2

  
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**Course Objectives**

1. To learn about different testing methods of materials
2. To understand the methods to determine various mechanical properties
3. To develop knowledge on the effect of heat treatment process on different materials
4. To understand the effect of stresses for different type of loading
5. To examine the microstructure of different materials

**S.No****LIST OF EXPERIMENTS**

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen- Charpy and Izod
5. Deflection test on beams
6. Hardness test on metals - Brinell and Rockwell Hardness Number
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Tempering- Improvement Mechanical properties Comparison  
(i)Unhardened specimen  
(ii) Quenched Specimen and  
(iii) Quenched and tempered specimen.
10. Microscopic Examination of  
(i) Hardened samples and  
(ii)Hardened and tempered samples.

**TOTAL: 45 PERIODS****Course Outcomes**

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


- CO1: Ability to perform different destructive testing  
 CO2: Ability to characteristic materials  
 CO3: Able to choose materials based upon loading and properties  
 CO4: Analyze the behaviour of material for various loading  
 CO5: Classify the material based upon microstructure

**LIST OF EQUIPMENTS**


S.No	NAME OF THE EQUIPMENT	QTY.
1	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7	Metallurgical Microscopes	1
8	Muffle Furnace (800 C)	1

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	2	-	3	2	-	3	-	2	3	2
CO2	3	3	2	2	2	-	2	-	-	2	-	1	3	2
CO3	3	3	2	2	2	2	2	2	-	2	-	2	3	2
CO4	3	2	1	2	-	-	2	-	-	2	-	2	3	2
CO5	3	2	2	2	2	-	2	-	-	2	-	2	3	2
AVG	3	2.4	1.8	2.2	2	2	2.2	2	-	2.2	-	1.8	3	2

  
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**Course Objectives**

1. To understand need for the rivet and welded joints
2. To recognize various threaded bolt and fasteners
3. To develop knowledge in select various types of fits, tolerance, hole and shaft basis systems
4. To familiarize students with reading of blue print and production drawing
5. To develop knowledge in machine elements part diagram and assembly

**UNIT I RIVET AND WELDED JOINTS**

(6)

Introduction – Rivet, Riveting, Caulking and Fullering – types heads – chain – Zig Zag rivet – Classification – Welded joints and symbols – Dimensioning method – Edge preparation method – Surface finish – Rules for applying symbol – welding process abbreviations

**UNIT II SCREWED FASTENERS AND BOLTED JOINTS**

(7)

Screw thread nomenclature – Forms of threads – types of thread profile – Designation – Multi-start – Right and Left hand threads – Representation – Bolted joints – Drawing of Square, Hexagonal and both head bolts – Types of Nuts, Bolts, cap, machine and set screws – Locking nuts – Foundation bolts

**UNIT III LIMITS, TOLERANCES AND FITS**

(6)

Limit systems – Deviations – Allowance – Size – Fundamental tolerances – hole and shaft deviations – Placing method – simple problems – Fits – Types of fits – Tolerance representation in drawing – Industry Standards

**UNIT IV BLUE PRINT READING AND PRODUCTION DRAWING**

(6)

Introduction – Blue print reading and practice – Rear tool post – Pump housing – Gear Box cover – Production drawing – Part – Work assembly drawing – Simple examples

**UNIT V MANUAL DRAWING PRACTICE**

(20)

Detailed drawings of following machine parts are given and draw the Elevations / Sectional elevations / Plan / and Side views with dimensioning and bill of materials – Sleeve & Cotter joint – Knuckle joint – Flanged coupling – Universal Coupling – Pulleys – Engine parts – Stuffing Box – Piston – Single plate clutch

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Ability to understand the various types of joining process
- CO2: Able to know the various types of screws and bolts
- CO3: Apply the knowledge of fits and tolerance to various applications
- CO4: Acquire the knowledge of study of blue print and production drawing
- CO5: Construct an assembly drawing with various part drawings of machine components

**Text Books**

- T1 Narayana, K L, Kanniah, P, Venkata Reddy, K., "Machine Drawing", New age International Pvt Ltd., 2006.
- T2 Gopalakrishna K R, "Machine Drawing", Seventeenth Edition, Subhas Stores, Bangalore, 2007.

**References**

- R1 Bhatt N. D, "Machine Drawing", Charotar Publishing House, Anand, 1999.
- R2 Gill, P S, "A Text book of Machine Drawing", Kataria & Sons, Delhi, 2017

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	2	-	3	2	-	3	-	2	2	2
CO2	3	3	2	2	2	-	2	-	-	2	-	1	3	2
CO3	3	3	2	2	2	2	2	2	-	2	-	2	3	2
CO4	3	2	1	2	-	-	2	-	-	2	-	2	2	2
CO5	3	2	2	2	2	-	2	-	-	2	-	2	2	2
AVG	3	2.4	1.8	2.2	2	2	2.2	2	-	2.2	-	1.8	2.4	2

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Programme	Course Code	Course Title	L	T	P	C
BE	22HE3071	Soft Skills and Aptitude - II	0	0 <sup>0</sup>	0	1

- Course Objectives:**
1. Solve Logical Reasoning questions of easy to intermediate level
  2. Solve Quantitative Aptitude questions of easy to intermediate level
  3. Solve Verbal Ability questions of easy to intermediate level
  4. Display good writing skills while dealing with essays

Unit	Description	Instructional Hours
I	<b>Logical Reasoning</b> Clocks - Calendars - Direction Sense - Cubes - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	9
II	<b>Quantitative Aptitude</b> Time and work: Work with different efficiencies, Pipes and cisterns, Work equivalence, Division of wages - Time, Speed and Distance: Basics of time, speed and distance, Relative speed, Problems based on trains, Problems based on boats and streams, - Profit and loss, Basic terminologies in profit and loss - Averages - Weighted average	12
III	<b>Verbal Ability</b> Sentence Correction: Subject-Verb Agreement, Modifiers, Parallelism, Pronoun-Antecedent Agreement, Verb Time Sequences, Comparisons, Prepositions, Determiners - Sentence Completion and Para-jumbles: Pro-active thinking, Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues), Fixed jumbles, Anchored jumbles.	7
IV	<b>Writing skills for placements</b> Essay writing: Idea generation for topics, Best practices, Practice and feedback	2
<b>Total Instructional Hours</b>		30

- Course Outcome :**
- CO1 : Students will avoid the various fallacies that can arise through the misuse of logic.
  - CO2 : Students would opt for alternate methods to solve the problems rather than conventional methods.
  - CO3 : Students will heighten their awareness of correct usage of English grammar in writing and speaking
  - CO4 : Students will be concise and clear, using professional language for placements.

  
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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E.	22MC3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2	0	0	0

**The student should be able**

- Course Objective**
- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
  - To make the students understand the traditional knowledge and analyze it and apply it to their day to day life.
  - To impart basic principles of thought process. Itihas and Dharma Shastra and connecting society and nature.
  - To understand the concept of Intellectual and intellectual property rights with special Reference.
  - The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and Indian philosophy

Unit	Description	Instructional Hours
I	<b>Introduction to traditional knowledge:</b> Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vs indigenous knowledge, traditional knowledge vs western knowledge	6
II	<b>Protection of traditional knowledge:</b> The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Government to harness TK	6
III	<b>Itihas and Dharma-Shastra</b> <b>Itihas:</b> The Mahabharata - The Puranas - The Ramayana <b>Dharma-Shastra:</b> Manu Needhi - The Tirukkural – Thiru Arutpa	6
IV	<b>Traditional knowledge and intellectual property:</b> Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge	6
V	<b>Indian philosophy</b> Jain – Buddhist – Charvaka – Samkhya - Yoga - Nyaya - Vaisheshika - Saiva Siddhanta	6
<b>Total Instructional Hours</b>		

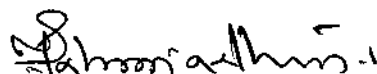
**After completion of the course the learner will be able**

**Course Outcome**

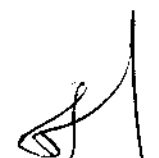
- Identify the concept of Traditional knowledge and its importance.
- Explain the need and importance of protecting traditional knowledge.
- Explain the need and importance of Itihas and Dharma Shastra.
- Interpret the concepts of Intellectual property to protect the traditional knowledge.
- Interpret the concepts of indian philosophy to protect the traditional knowledge.

**REFERENCE BOOKS:**

- Traditional Knowledge System in India, by Amit Jha, 2009.
- Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
- "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.
- V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
- V N Jha ( Eng. Trans.), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am.

  
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**DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS**

**CBCS PATTERN**

**UNDERGRADUATE PROGRAMMES**

**B.E. AUTOMOBILE ENGINEERING (UG)**

**REGULATION-2022**

(For the students admitted during the academic year 2022-2026)

**SEMESTER I**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2.	22ME1201	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
3.	22PH1151	Physics for Non-Circuit Engineering	BSC	2	0	2	3	4	50	50	100
4.	22HE1151	English for Engineers	HSC	2	0	2	3	4	50	50	100
5.	22IT1151	Python Programming and Practises	ESC	2	0	2	3	4	50	50	100
<b>EEC COURSES (SE/AE)</b>											
6.	22HE1071	UHV	AEC	2	0	0	0	3	40	60	100
7.	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSE</b>											
8.	22MC1091/ 22MC1092	தமிழரும் தொழில் நுட்பமும் / Indian Constitution	MC	2	0	0	1	2	0	0	0
<b>TOTAL</b>				<b>15</b>	<b>5</b>	<b>6</b>	<b>18</b>	<b>27</b>	<b>370</b>	<b>330</b>	<b>700</b>

**SEMESTER II**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA2101	Differential equations and complex analysis	BSC	3	1	0	4	4	40	60	100
2.	22CY2101	Environmental Studies	ESC	2	0	0	2	3	40	60	100

3.	22PH2101	Basics of Material Science	BSC	2	0	0	2	3	40	60	100
4.	22ME2101	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5.	22CY2152	Applied Chemistry	BSC	2	0	2	3	4	50	50	100
6.	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
7.	22ME2001	Engineering Practices	ESC	0	0	4	2	2	50	50	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE2071	Design Thinking	AEC	2	0	0	2	2	100	0	100
9.	22HE2072	Soft Skills -I	AEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSE</b>											
10.	22MC2091/ 22MC2092	தமிழர் மரபு / Heritage of Tamils	MC	2	0	0	1	2	100	0	100
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
<b>TOTAL</b>				<b>19</b>	<b>2</b>	<b>12</b>	<b>23</b>	<b>28</b>	<b>610</b>	<b>390</b>	<b>1000</b>

### SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA3104	Fourier analysis and numerical techniques	BSC	3	1	0	4	4	40	60	100
2.	22AU3201	Fundamentals of Automotive Engines	PCC	3	0	0	3	3	40	60	100
3.	22AU3202	Fundamentals of Thermodynamics	PCC	3	1	0	4	3	40	60	100
4.	22AU3203	Mechanics of Materials	PCC	3	1	0	4	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5.	22AU3251	Manufacturing Technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
6.	22AU3001	Automotive Components Lab	ESC	0	0	4	2	4	60	40	100
7.	22AU3002	Mechanics of Materials Lab	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE3071	Soft Skills -2	SEC	1	0	0	1	1	100	0	100
9.	22AU3072	Machine Drawing	AEC	0	0	4	2	2	60	40	100
10.	22MC3092	Essence of Indian Traditional Knowledge	AEC	2	0	0	0	0	-	-	-
<b>TOTAL</b>				<b>19</b>	<b>3</b>	<b>10</b>	<b>25</b>	<b>29</b>	<b>470</b>	<b>430</b>	<b>900</b>



### SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2.	22AU4201	Automotive Chassis components Design	BSC	3	1	0	4	4	40	60	100
3.	22AU4202	Automotive Electricals and Electronics systems	PCC	3	0	0	3	3	40	60	100
4.	22AU4203	Mechanics of Machines	PCC	3	1	0	4	4	40	60	100
5.	22AU4204	Fluid Mechanics and Actuating Systems	PCC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU4251	Fundamentals of Heat Transfer	PCC	3	0	2	3	4	40	60	100
<b>PRACTICAL</b>											
7.	22AU4001	Automotive Electricals and Electronics Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU4002	Computer Aided Engine components design Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE4071	Soft Skills -III	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>2</b>	<b>10</b>	<b>24</b>	<b>29</b>	<b>460</b>	<b>440</b>	<b>900</b>
<p>* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same will be evaluated in Semester IV.                      If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed with Internship II (Total: 4 weeks-2 credits)</p>											

### SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU5201	Vehicle design and data characteristics	PCC	3	0	0	3	4	40	60	100
2.	22AU5202	Automotive Fuels and Lubricants	PCC	3	0	0	3	3	40	60	100
3.	22AU53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	22AU53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	22AU53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU5251	Two and Three-wheeler technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
7.	22AU5001	Automotive Fuels and Lubricants Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE5072	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>6</b>	<b>21</b>	<b>25</b>	<b>410</b>	<b>390</b>	<b>800</b>



**SEMESTER VI**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU6201	Vehicle Dynamics	PCC	3	0	0	3	3	40	60	100
2.	22HE6101	Professional Ethics (Common)	HSC	3	0	0	3	3	40	60	100
3.	22AU63XX	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4.	22AU63XX	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5.	22XX64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6.	22XX64XX	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
7.	22AU6001	Computer Aided Engineering Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU6002	Engine Performance and Emission testing laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE6071	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
<b>TOTAL</b>				<b>20</b>	<b>0</b>	<b>8</b>	<b>24</b>	<b>28</b>	<b>460</b>	<b>440</b>	<b>900</b>

**SEMESTER VII**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU7201	Design of Automotive Transmission systems	PCC	3	0	0	3	3	40	60	100
2.	22AU7202	Engine and Vehicle Management systems	PCC	3	1	0	4	4	40	60	100
3.	22AU73XX	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
4.	22XX7401	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5.	22LS74XX	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
6.	22AU7001	Vehicle Maintenance Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
7.	22AU7701	Internship - II'	SEC	-	-	-	2	1	100	0	100
<b>TOTAL</b>				<b>15</b>	<b>1</b>	<b>4</b>	<b>20</b>	<b>21</b>	<b>360</b>	<b>340</b>	<b>700</b>

\* - Two weeks internship carries 1 credit and it will be done during Semester VI summer vacation/placement training and same will be evaluated in Semester VII.

**SEMESTER VIII**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	*CIA	ESE	Total
<b>EEC COURSES (SE/AE)</b>											
I.	22AU8901	Project Work/Granted Patent	SEC9	0	0	20	10	20	100	100	200
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>	<b>20</b>	<b>100</b>	<b>100</b>	<b>200</b>

**Note:**

- \*As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
- NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
- The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22.

**SEMESTER-WISE CREDIT DISTRIBUTION**

<b>B.E. / B.TECH. PROGRAMMES</b>										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	-	-	-	-	-	20
3	ESC	6	7	2	-	-	-	-	-	15
4	PCC	-	-	16	20	12	7	9	-	64
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	6	6	-	12
7	EEC	1	3	3	1	1	2	2	10	25
8	MCC	1	1	-	-	-	-	-	-	-
<b>Total</b>		<b>18</b>	<b>23</b>	<b>25</b>	<b>23</b>	<b>22</b>	<b>24</b>	<b>20</b>	<b>10</b>	<b>165</b>

**OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)**

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3
4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

### OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Biorefinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

### OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU7401	Automotive Fault diagnosis systems	OEC	3	0	0	3	3

### OPEN ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3

5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1 Modern Mobility Systems	Vertical 2 Product and Process Development	Vertical 3 Robotics and Automation	Vertical 4 Digital and Green Manufacturing	Vertical 5 Clean and Green Energy Technologies	Vertical 6 Core Elective
22AU5301 Automotive Materials, Design and Testing	22AU5304 Value Engineering	22AU5307 Sensors and Instrumentation	22AU5310 Digital Manufacturing and IoT	22AU5313 Bioenergy Conversion Technologies	22AU5316 Automotive Chassis
22AU5302 Futuristic Vehicle Technology	22AU5305 Additive Manufacturing	22AU5308 Electrical Drives and Actuators	22AU5311 Lean Manufacturing	22AU5314 Solar Thermal Technology	22AU5317 Automotive Transmission
22AU5303 Renewable Energy and Emission Control Technology for Off Road Vehicles	22AU5306 CAD/CAM	22AU5309 Embedded Systems and Programming	22AU5312 Modern Robotics	22AU5315 Energy Conservation in Industries	22AU5318 Alternate Fuels and Energy Systems
22AU6301 Vehicle Health Monitoring, Maintenance and Safety	22AU6303 Ergonomics in Design	22AU6305 Robotics	22AU6307 Green Manufacturing Design and Practices	22AU6309 Energy Efficient Buildings	22AU6311 Automotive Engine Components design
22AU6302 Hybrid and Electric Vehicle Technology	22AU6304 New Product Development	22AU6306 Smart Mobility and Intelligent Vehicles	22AU6308 Environment Sustainability and Impact Assessment	22AU6310 Renewable Energy Technologies	22AU6312 Finite Element Analysis
22AU7301 Thermal Management of Batteries and Fuel Cells	22AU7302 Product Life Cycle Management	22AU7303 Haptics and Immersive Technologies	22AU7304 Green Supply Chain Management	22AU7305 Equipment for Pollution Control	22AU7306 Automotive Pollution and Control

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

#### Details of Vertical I: MODERN MOBILITY SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATEG ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5301	Automotive Materials, Design and Testing	PEC	3	0	0	3	3
2	22AU5302	Futuristic Vehicle Technology	PEC	3	0	0	3	3
3	22AU5303	Renewable Energy and Emission Control Technology for Off Road Vehicles	PEC	3	0	0	3	3

4	22AU6301	Vehicle Health Monitoring, Maintenance and Safety	PEC	3	0	0	3	3
5	22AU6302	Hybrid and Electric Vehicle Technology	PEC	3	0	0	3	3
6	22AU7301	Thermal Management of Batteries and Fuel Cells	PEC	3	0	0	3	3

**Details of Vertical II: PRODUCT AND PROCESS DEVELOPMENT**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5304	Value Engineering	PEC	3	0	0	3	3
2	22AU5305	Additive Manufacturing	PEC	3	0	0	3	3
3	22AU5306	CAD/CAM	PEC	3	0	0	3	3
4	22AU6303	Ergonomics in Design	PEC	3	0	0	3	3
5	22AU6304	New Product Development	PEC	3	0	0	3	3
6	22AU7302	Product Life Cycle Management	PEC	3	0	0	3	3

**Details of Vertical III: ROBOTICS AND AUTOMATION**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5307	Sensors and Instrumentation	PEC	3	0	0	3	3
2	22AU5308	Electrical Drives and Actuators	PEC	3	0	0	3	3
3	22AU5309	Embedded Systems and Programming	PEC	3	0	0	3	3
4	22AU6305	Robotics	PEC	3	0	0	3	3
5	22AU6306	Smart Mobility and Intelligent Vehicles	PEC	3	0	0	3	3
6	22AU7303	Haptics and Immersive Technologies	PEC	3	0	0	3	3

**Details of Vertical IV: DIGITAL AND GREEN MANUFACTURING**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5310	Digital Manufacturing and IoT	PEC	3	0	0	3	3
2	22AU5311	Lean Manufacturing	PEC	3	0	0	3	3
3	22AU5312	Modern Robotics	PEC	3	0	0	3	3
4	22AU6307	Green Manufacturing Design and Practices	PEC	3	0	0	3	3
5	22AU6308	Environment Sustainability and Impact Assessment	PEC	3	0	0	3	3
6	22AU7304	Green Supply Chain Management	PEC	3	0	0	3	3

**Details of Vertical V: CLEAN AND GREEN ENERGY TECHNOLOGIES**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5313	Bioenergy Conversion Technologies	PEC	3	0	0	3	3
2	22AU5314	Solar Thermal Technology	PEC	3	0	0	3	3
3	22AU5315	Energy Conservation in Industries	PEC	3	0	0	3	3
4	22AU6309	Energy Efficient Buildings	PEC	3	0	0	3	3
5	22AU6310	Renewable Energy Technologies	PEC	3	0	0	3	3
6	22AU7305	Equipment for Pollution Control	PEC	3	0	0	3	3

**Details of Vertical VI: CORE ELECTIVE**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5316	Automotive Chassis	PEC	3	0	0	3	3
2	22AU5317	Automotive Transmission	PEC	3	0	0	3	3
3	22AU5318	Alternate Fuels and Energy Systems	PEC	3	0	0	3	3
4	22AU6311	Automotive Engine Components design	PEC	3	0	0	3	3
5	22AU6312	Finite Element Analysis	PEC	3	0	0	3	3
6	22AU7306	Automotive Pollution and Control	PEC	3	0	0	3	3

**Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

**Clause 4.10** of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

**VERTICALS FOR MINOR DEGREE**

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.  
Note: Each programme should provide verticals for minor degree

Minor Degree - Automotive Vehicle Technology (Offered by Automobile Engineering )									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5601	Automotive Engines	3	0	0	3	40	60	100
2	22AU6601	Automotive Chassis	3	0	0	3	40	60	100
3	22AU6602	Automotive Transmission	3	0	0	3	40	60	100
4	22AU7601	Automotive Electronics	3	0	0	3	40	60	100
5	22AU7602	Intelligent vehicular systems	3	0	0	3	40	60	100
6	22AU8601	Electric and Hybrid vehicles	3	0	0	3	40	60	100

Minor Degree - Fintech and Block Chain (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CS5601	Financial Management	3	0	0	3	40	60	100
2	22CS5602	Fundamentals of Investment	3	0	0	3	40	60	100
3	22CS5603	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	22CS5604	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	22CS5605	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	22CS5606	Introduction to Fintech	3	0	0	3	40	60	100

Minor Degree - Entrepreneurship (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22BA5601	Foundation of Entrepreneurship	3	0	0	3	40	60	100
2	22BA6601	Introduction to Business Venture	3	0	0	3	40	60	100
3	22BA6602	Team Building & Leadership Management for Business	3	0	0	3	40	60	100
4	22BA7601	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100
5	22BA7602	Principles of Marketing Management for Business	3	0	0	3	40	60	100
6	22BA8601	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100

Minor Degree - Environment and Sustainability (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CEXXXX	Sustainable infrastructure Development	3	0	0	3	40	60	100
2	22CEXXXX	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
3	22CEXXXX	Sustainable Bio Materials	3	0	0	3	40	60	100
4	22CEXXXX	Materials for Energy Sustainability	3	0	0	3	40	60	100
5	22CEXXXX	Green Technology	3	0	0	3	40	60	100
6	22CEXXXX	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100

Honors Degree - Electric and hybrid vehicle development									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5203	Fundamentals of Electric and Hybrid Vehicles	3	0	0	3	40	60	100
2	22AU6202	Battery Technology	3	0	0	3	40	60	100
3	22AU6203	Automotive Embedded Systems	3	0	0	3	40	60	100
4	22AU7203	Advanced Automotive Safety Systems	3	0	0	3	40	60	100
5	22AU7204	Special Purpose Electric Vehicle	3	0	0	3	40	60	100
6	22AU8201	Electric Vehicles and its Sustainable Development	3	0	0	3	40	60	100
Honors Degree - Motorsport Engineering									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5204	Composite Structure	3	0	0	3	40	60	100
2	22AU6204	High performance engine design	3	0	0	3	40	60	100
3	22AU6205	Motorsports Electric Vehicle	3	0	0	3	40	60	100
4	22AU7205	Motorsports Vehicle Body Engineering	3	0	0	3	40	60	100
5	22AU7206	Motorsports Race Electronics and Control Systems	3	0	0	3	40	60	100
6	22AU8202	Motorsports racing circuits and Design	3	0	0	3	40	60	100
Honors Degree - Vehicle Development and Validation									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5205	Automotive Product Design and Development	3	0	0	3	40	60	100
2	22AU6206	Noise, Vibration and Harshness	3	0	0	3	40	60	100
3	22AU6207	Automotive Instrumentation	3	0	0	3	40	60	100
4	22AU7207	Testing and Measurement Systems	3	0	0	3	40	60	100
5	22AU7208	Homologation	3	0	0	3	40	60	100
6	22AU8203	Automotive Prototyping	3	0	0	3	40	60	100

### CREDIT DISTRIBUTION

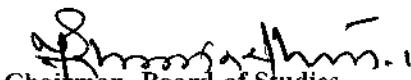
Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	26	24	18	14	165

\* Student can earn extra credit 35 over and above the total credits


ADDITIONAL CREDIT COURSE FOR NCC CADETS											
S.No	Course code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL	
1	22HE1074	NCC General and National Integration	VA	1	0	0	1	100	0	100	
2	22HE2074	Social Services and Community Development	VA	1	0	0	1	100	0	100	
3	22HE3074	Leadership Qualities and Camp Activities	VA	1	0	0	1	100	0	100	
4	22HE4074	General awareness, communication and Aero engines	VA	1	0	0	1	100	0	100	

ADDITIONAL CREDIT COURSE FOR AUTOMOBILE ENGINEERING						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1	22VAAU01	Foundry Technology	VA	30 hrs	Internal	1
2	22VAAU02	Forming and Shaping of Plastics	VA	30 hrs	Internal	1
3	22VAAU03	Microcontroller Programming in Automotive applications	VA	30 hrs	Internal	1
4	22VAAU04	Vehicle development and testing regulations (ARAI)	VA	30 hrs	Internal	1
5	22VAAU05	Bigdata Analysis	VA	30 hrs	Internal	1
6	22VAAU06	Data mining	VA	30 hrs	Internal	1
7	22VAAU07	Fire and safety Engineering	VA	30 hrs	Internal	1
8	22VAAU08	Introduction to MS office	VA	30 hrs	Internal	1
9	22VAAU09	Advanced Automotive Electrical and Electronics	VA	30 hrs	Internal	1
10	22VAAU10	Autodesk Fusion 360	VA	30 hrs	Internal	1

**Note: Non Credit Course results will not consider for Award of Degree**

  
Chairman, Board of Studies  
**Chairman - BoS**  
**AUTO - HICET**

  
Dean - Academics  
**Dean (Academics)**  
**HICET**

  
Principal  
**PRINCIPAL**  
Hindusthan College Of Engineering & Technology  
COIMBATORE - 641 032.

**Course Objectives**

1. To define the selection procedure of various vehicle specifications for design.
2. To acquire knowledge about the resistance offered to a vehicle and its effects in performance.
3. To understand the calculative method of FHP and engine cubic capacity.
4. To understand the method of designing of an engine.
5. To understand about the working of fuel systems in a modern vehicle.

**UNIT I INTRODUCTION****(09)**

Study of vehicle specifications – Calculation of Engine power and efficiency – Performance Curve - Acceleration, Gradeability and Drawbar pull, Vehicle speed Vs. BMEP, torque and mechanical efficiency.

**UNIT II RESISTANCE TO VEHICLE MOTION****(09)**

Calculation of Air resistance, Rolling resistance and Gradient resistance against various vehicle running conditions. Relationship between engine speed and vehicle speed.

**UNIT III FHP AND ENGINE CAPACITY****(09)**

PV diagram – Theoretical and actual. Frictional Mean Effective Pressure calculation methods – Calculation of Engine Cubic Capacity.

**UNIT IV ENGINE DESIGN****(09)**

Derivation of connecting rod length to crank radius ratio, velocity of piston and angular velocity of connecting rod – Inertia force, gas force and resultant force against Crank Angle.

**UNIT V FUEL SYSTEMS****(09)**

Air and Fuel flow in carburetor – Critical velocity – Orifice diameter and throat diameter calculation. CI engine fuel supply system – Calculation of amount of fuel injected and time of injection per cycle.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Demonstrate the design requirements of a vehicle design and procedure.  
 CO2: Apply the resistance offered to the vehicle and its ability to propel.  
 CO3: Acquired the performance of the engine and its capacity.  
 CO4: Approach design concepts of an engine and understand the forces acting within the engine.  
 CO5: Interpret the working and effectiveness of the fuel systems of a vehicle.

**Text Books**

- T1 Giri. N. K., "Automotive Mechanics", Khanna Publishers, New Delhi, 2015  
 T2 Heldt, P.M., "High Speed Combustion Engines", Oxford and I.B.H. Publishing Co., Kolkata, 2015.

**References**

- R1 Gupta. R.B., "Automobile Engineering", SathyaPrakashan, 2016.

CO PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	1	3	1	2				1			1	1	2
CO2	2	1	3	1	2				1			1	1	2
CO3	2	1	3	1	2				1			1	1	2
CO4	2	1	3	1	2				1			1	1	2
CO5	2	1	3	1	2				1			1	1	2
AVG	2	1	3	1	2				1			1	1	2

*[Handwritten Signature]*  
 Chairman, Board of Studies  
**Chairman - BoS**  
**AUTO - HICET**



*[Handwritten Signature]*  
 Dean - Academics

**Course Objectives**

1. To understand the manufacture of fuels and lubricants for the design and operation of the I.C engines.
2. To understand the different types of lubrication used in the automotive fuels and lubricants
3. To summarize the properties, additives and mechanism of lubricants.
4. To study the combustion characteristics of fuels in I.C. Engines
5. To Illustrate the combustion and fuel rating.

**UNIT I MANUFACTURE OF FUELS AND LUBRICANTS (9)**

Fuels-Structure of petroleum-refining process-Thermal cracking, catalytic cracking, polymerization, alkylation, isomerisation, blending- Manufacture of lubricating oil base stocks and finished automotive lubricants.

**UNIT II THEORY OF LUBRICATION (9)**

Engine friction- Introduction- Mechanical efficiency-Mechanical friction-Blow by losses-Pumping loss-factors affecting mechanical friction- Lubrication-function-mechanism -hydrodynamic lubrication, boundary lubrication, bearing lubrication.

**UNIT III LUBRICANTS (9)**

Specific requirements for automotive lubricants-oxidation deterioration and degradation of lubricants-additives and additive mechanism-classification of lubricating oils- properties of lubricating oils-tests on lubricants- Grease-classification- properties.

**UNIT IV COMBUSTION OF FUELS (9)**

Stoichiometry - calculation of theoretically correct air required for combustion of liquid and gaseous fuels volumetric and gravimetric analysis of the dry products of combustion-monoxide per kg of fuel-heat loss due to incomplete combustion- exhaust gas analysis by Orsat apparatus.

**UNIT V COMBUSTION AND FUEL STANDARDS (9)**

SI Engines – flame propagation and mechanism of combustion, normal combustion, knocking, octane rating, fuel requirements-CI Engine, mechanism of combustion, diesel knock, cetane rating, fuel requirements. Fuel standards – Worldwide and BS Standards.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Gain knowledge on the importance and manufacturing methods in fuels and lubricants.  
 CO2: Utilize the importance of theory of lubrication.  
 CO3: Summarize the properties, additives and mechanism of lubricants.  
 CO4: Show the combustion characteristics of fuels in IC engine  
 CO5: Inference the combustion of fuels and fuel rating in IC engines

**Text Books**

- T1 Ganesan.V, "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., 2012.  
 T2 Mathur. M.L., Sharma. R.P. "A course in internal combustion engines", Dhanpatrai publication, 2016.  
 T3 George E. Totten, Editor, Fuels and Lubricants Handbook: Technology, Properties, Performance, and Testing, ASTM International.


**References**

- R1 Paul Richards "Automotive fuels reference book" SAE International, Third edition 2014  
 R2 Roger Frederick Haycock, John Hillier, Arthur J. Caines "Automotive lubricants Reference book", SAE International, Second edition 2004

CO PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	3	2	-	3	2	-	3	-	2	2	2
CO2	2	3	2	2	2	-	2	-	-	2	-	1	3	2
CO3	3	3	2	2	2	2	2	2	-	2	-	2	3	2
CO4	2	2	1	2	-	-	2	-	-	2	-	2	2	2
CO5	2	2	2	2	2	-	2	-	-	2	-	2	2	2
AVG	2.2	2.4	1.8	2.2	2	2	2.2	2	-	2.2	-	1.8	2.4	2

  
 Chairman, Board of Studies  
**Chairman - BoS**  
**AUTO - HICET**

  
 Dean - Academics  
**Dean (Academics)**  
**HICET**

**Course Objectives**

1. To know and understand the constructional details, operating characteristics and regulations of two and three wheelers.
2. To obtain knowledge of vehicle frame structure and analyze it in two wheelers.
3. To Demonstrate the transmission and braking systems.
4. To acquire a knowledge in design of three wheelers for different application
5. To know about recent development and advancement in Two and Three Wheelers.

**UNIT I THE ENGINE AND FUEL SUPPLY SYSTEM (9)**

Two Wheeler – Types – Layouts – Engine – Two and Four stroke – Selection Criteria – Design Consideration – Carburetor – Different Circuits – Two Wheeler Carburetor – Fuel injection systems – Layout – Pump – Injector – ECU.

- Performance test of a two wheeler using chassis dynamometer.

**UNIT II VEHICLE FRAME AND WHEELS (9)**

Frame – Load – Design Consideration – Components – Mounting method – types of frame – frame material – Ergonomics – Wheel Types – Tyre – Designation – Requirements – Cross & Radial Ply – Tube – Tubeless Tyres.

- Performance test on shock absorber & Coil Spring

**UNIT III TRANSMISSION AND BRAKING SYSTEM (9)**

Transmission Layout – Primary Reduction – Clutch – Single, Multi and Centrifugal – Gear Box – Constant Mesh – Sequential – CVT – Final Drive – Brake action – Theory – Design Consideration – Drum & Disc Brake – Control System – Mechanical – Hydraulic – Master Cylinder – ABS.

- Dismantling and assembling of three wheeler box and finding gear ratios

**UNIT IV THREE WHEELER VEHICLES (9)**

Three Wheeler – Types – Layout – Loading Auto Rickshaws – Types – Engines types – Drive Train – Suspension – Rear – Passenger – Loading Auto – Braking System – Master Cylinder – Wheel Cylinder – Hand Brake – Frame and Body.

- Dismantling and assembling of three wheeler steering system.

**UNIT V CASE STUDY & RECENT DEVELOPMENTS (9)**

Case study of – Bike – Auto – Sports bike – Electric Bike – All terrain bike – Recent developments – ABS, DTSi, DTS-Si, CVTi, CDI, ATFI, Triple Spark, Self-balancing vehicles, Engine electronics, Exhaust TEC, Ecothrust Technology.

- Two wheeler chain test

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Summarize the various subsystem of two and three wheeler.  
 CO2: Illustrate parts with vehicle frame of two wheelers.  
 CO3: Organize the Transmission and braking System of two wheelers.  
 CO4: Rephrase the three wheelers systems and functionality.  
 CO5: Outline the various new advancements in two and three wheelers technology.

**Text Books**

- T1 Dhruv U Panchal, "Two and Three Wheeler Technology", PHI Learning Pvt., Ltd., 2015  
 T2 Ramalingam. K. K., "Two Wheelers", Scitech publications, 2016.

**References**


- R1 John Robinson, "Service Manuals of Manufacturers of Indian Two & Three wheelers.

CO PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2		3	3		1	2	2	2			3	1
CO2	3	2	3			3	2	2	2		3		2	2
CO3	3		3			2	2	2	2	2			2	2
CO4	3		2	1	3	1			2		3		3	
CO5	3			3	3			2					3	
AVG	3	2	2.6	2.4	3	2	2.5	2	2	2	3		2.6	2.5

  
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**Course Objectives**

1. To do independent experiments to find out the properties of fuels and lubricants
2. To grasp the importance of viscosity in the fuels and lubricants
3. To be familiar with the calorific value of liquids and gaseous fuels.
4. To conduct experiment on carbon, copper residue and ash content test
5. To conduct experiment on drop point and mechanical penetration test of grease.

**LIST OF EXPERIMENTS**

1. ASTM distillation test of liquid fuels.
2. Aniline Point test of diesel.
3. Calorific value of liquid fuel.
4. Calorific value of gaseous fuel.
5. Reid vapour pressure test.
6. Flash and Fire points of petrol and diesel.
7. Copper strip Corrosion Test.
8. Cloud & Pour point Test.
9. Temperature dependence of viscosity of lubricants & Fuels by Redwood Viscometer.
10. Viscosity Index of lubricants & Fuels by Saybolt Viscometer.
11. Ash content and Carbon Residue Test.
12. Drop point of grease and mechanical penetration in grease.

**TOTAL: 45 PERIODS****Course Outcomes.**

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

- CO1: Develop to produce high focused independent practical skill on fuels and lubricants.
- CO2: Identify how they can be involved in doing experiments
- CO3: Construct an in-depth analysis related with any fuel / lubricant.
- CO4: Describe how the temperature and friction can influence the properties of fuels and lubricants
- CO5: Experiment with the properties of grease.

**LIST OF EQUIPMENTS**

Sl.No.	Name of the equipment	Quantity
1.	Flash and fire point apparatus (for Petrol)	1
2.	Aniline point Apparatus	1
3.	Reid vapor pressure test Apparatus	1
4.	Bomb and Gas Calorimeters	1
5.	Carbon Residue Test Apparatus	1
6.	Copper Strip Corrosion Test Apparatus	1
7.	Cloud and Pour point Apparatus	1
8.	Redwood Viscometer	1
9.	Saybolt Viscometer	1
10.	ASTM distillation test Apparatus	1
11.	Ash content Test Apparatus	1
12.	Drop point and penetration Apparatus for grease	1

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	3	3	3	3	-	-	3	-	3	3	2
CO2	2	2	2	2	3	2	2	-	-	3	-	3	3	2
CO3	3	2	2	3	3	2	2	-	-	3	-	2	3	2
CO4	2	3	2	3	3	3	2	-	-	2	-	2	2	2
CO5	1	3	1	3	2	3	2	-	-	2	-	2	2	2
AVG	2.2	2.6	1.8	2.8	2.8	2.6	2.2	-	-	2.6	-	2.4	2.6	2

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE5072	Soft Skills - IV	0	0	0	1

**Course Objectives:**

1. To employ soft skills to enhance employability and ensure workplace and career success.
2. To interpret things objectively, to be able to perceive and interpret trends to make generalizations and be able to analyze assumptions behind an argument/statement.

Unit	Description	Instructional Hours
I	<b>Introduction to Soft Skills:</b> Introduction- Objective -Hard vs Soft Skills - Measuring Soft Skills- Structure of the Soft Skills -Self management-Critical thinking-Reflective thinking and writing- p2p Interaction	10
II	<b>Art of Communication:</b> Verbal Communication - Effective Communication - Active listening –Paraphrasing - Feedback - Non Verbal Communication – Roles-Types- How nonverbal communication can go wrong- How to Improve non verbal Communication - Importance of feelings in communication - dealing with feelings in communication.	10
III	<b>World of Teams:</b> Self Enhancement - importance of developing assertive skills- developing self confidence – developing emotional intelligence - importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved - Working with Groups – Dealing with People- Group Decision Making.	10
<b>Total Instruction Hours</b>		30

**Course Outcome:**

CO1: Students will have clarity on their career exploration process and to match their skills and interests with a chosen career path.

CO2: Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others

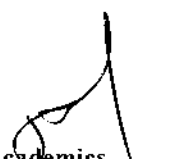
CO3: Students will understand how teamwork can support leadership skills

### REFERENCE BOOKS:

R1:	Soft Skills Training: A Workbook to Develop Skills for Employment - Frederick H. Wentz
R2:	Bridging the Soft Skills Gap: How to Teach the Missing Basics to Today's Young Talent – by Bruce Tulgan
R3:	Soft Skills Training: A Workbook to Develop Skills for Employment – by Frederick H. Wentz

  
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**Course Objectives**

1. To understand the concept of limit, fit and tolerance and design procedure of cylinder
2. To know the materials selection, design procedure of piston and connecting rod
3. To recognize the material selection and design procedure of crankshaft and flywheel
4. To apply the design concept of valves, manifold and pushrod
5. To study about various testing used on engine components.

**UNIT I DESIGN OF CYLINDER**

(9)

Materials properties. Limit, Fits – Clearance fit, interference fit and transition fit, Tolerances – Unilateral and bilateral tolerances. Material selection and design of cylinder. Function of liner & its types.

**UNIT II DESIGN OF PISTON & CONNECTING ROD**

(9)

Material selection and design of piston, piston pin and piston rings. Material selection and design of connecting rod and big end bolts.

**UNIT III DESIGN OF CRANKSHAFT AND FLYWHEEL**

(9)

Material selection and design of crank shaft. Significance of firing order. Design of flywheel – Turning moment diagram

**UNIT IV DESIGN OF VALVES, MANIFOLD AND PUSH ROD**

(9)

Material selection and design of valves, valve springs and tappets. Design of intake and exhaust manifold. Design of push rod.

**UNIT V TESTING OF ENGINE COMPONENTS**

(9)

Cylinder block testing – Magnetic particle inspection, Dye penetrate inspection, pressure testing. Testing on Connecting Rod – Fatigue test, Crack detection test on crankshaft.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the concept of limit, fit and tolerance and design procedure of cylinder  
 CO2: Know the materials selection, design procedure of piston and connecting rod  
 CO3: Recognize the material selection and design procedure of crankshaft and flywheel  
 CO4: Apply the design concept of valves, manifold and pushrod  
 CO5: Understand various testing used on engine components

**Text Books**

- T1 Khurmi, R.S. & Gupta, J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.  
 T2 The Automotive Chassis: Volume I: Components Design (Mechanical Engineering Series) by Giancarlo Genta and Lorenzo Morello | 24 December 2019  
 T3 Jain.R.K, "Machine Design", Khanna Publishers, New Delhi, 2005.

**References**

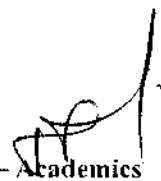
- R1 Manufacturing Automotive Components from Sustainable Natural Fiber Composites (SpringerBriefs in Materials) by Lobna A. Elseify, Mohamad Midani, et al. | 9 August 2021  
 R2 Hiroshima Yamagata, "The science and technology of materials in automotive engines", Woodhead Publishing Limited, Cambridge, England  
 R3 Mechanical and Materials Engineering of Modern Structure and Component Design (Advanced Structured Materials Book 70) by Andreas Öchsner and Holm Altenbach | 6 June 2015

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	3	2	2	-	-	-	1	-	-	1	3	3
CO2	3	2	3	2	2	-	-	-	1	-	-	1	3	3
CO3	3	2	3	2	2	-	-	-	1	-	-	1	3	3
CO4	3	2	3	2	2	-	-	-	1	-	-	1	3	3
CO5	3	2	3	2	2	-	-	-	1	-	-	1	3	3
AVG	3	2	3	2	2	-	-	-	1	-	-	1	3	3

  
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**Course Objectives**

1. To study about advanced engine technologies and its components
2. To learn about advanced combustion technology
3. To acquire knowledge about hybrid and electric vehicle technology
4. To understand fuel cell technology
5. To familiarize about recent trends in automotive technology

**UNIT I ADVANCED ENGINE TECHNOLOGY****(9)**

Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, Electric EGR.

**UNIT II ADVANCED COMBUSTION TECHNOLOGY****(9)**

Dual Fuel Combustion, Homogeneous Charge Combustion Ignition (HCCI), Premixed Charge Compression Ignition, Reactivity Controlled Compression Ignition (RCCI).

**UNIT III HYBRID AND ELECTRIC VEHICLE TECHNOLOGY****(9)**

Conventional Hybrids (Conventional ICE + Battery), Modern Hybrids (RCCI/GDCI Engine +- Battery) – Series, Parallel, Series-Parallel, Complex HEVs, Pure Electric Vehicle Technology

**UNIT IV FUEL CELL TECHNOLOGY****(9)**

Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell

**UNIT V RECENT TRENDS****(9)**

Advanced driver assistance systems (ADAS), Internet of Things (IoT) Technology, Intelligent all wheel drive, Mobility as a Service (MaaS), Active Aerodynamics.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Identify the advanced engine technology and its components  
 CO2: Understand the advanced combustion technology  
 CO3: Know about the working of hybrid and electric vehicle technology  
 CO4: Discuss the working of fuel cell technology  
 CO5: Analyze the need and working of recent trends in automotive industry

**Text Books**

- T1 Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.  
 T2 Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines. ISBN 978-3-319-68507-6, SPRINGER  
 T3 Toward Zero Carbon: The Chicago Central Area DeCarbonization Plan by Adrian Smith and Gordon Gill | 1 June 2011

**References**


- R1 Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport (Green Energy and Technology) by Kathryn G. Logan, Astley Hastings, et al. | 7 April 2022

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	1	1	1	-	-	-	1	-	-	1	3	2
CO2	3	2	1	1	1	-	-	-	1	-	-	1	3	2
CO3	3	2	1	1	1	-	-	-	1	-	-	1	3	2
CO4	3	2	1	1	1	-	-	-	1	-	-	1	3	2
CO5	3	2	1	1	1	-	-	-	1	-	-	1	3	2
AVG	3	2	1	1	1	-	-	-	1	-	-	1	3	2

  
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**Course Objectives**

1. To educate the students about alcohol usage in automobiles
2. To learn and understand the green energy production methodologies and its use in off-road vehicle categories.
3. To study about bio-diesel and its suitability in off road vehicles applications
4. To familiarize about LPG and CNG usage in automotive technology
5. To understand in cylinder and after treatment technology

**UNIT I ALCOHOL (9)**  
Ethanol, Methanol, Butanol, - Production, Properties, Use of alcohols in SI and CI engines, performance of blending methanol with gasoline. Emulsification of alcohol and diesel. Dual fuel systems.

**UNIT II SOLAR POWER (9)**  
Solar cells for energy collection. Storage batteries, layout and working of solar powered automobiles. Advantages and limitations.

**UNIT III BIO DIESELS (9)**  
Base materials and Process of separation of Bio Diesel - Karanji oil, Neem oil, Sunflower oil, Soyabean oil, Mustard oil, Palm oil, Jatropha seeds. Properties Diesel blended with vegetable oil, and difference in performance of Engine.

**UNIT IV LPG AND CNG (9)**  
Properties of LPG & CNG as engine fuels, fuel metering systems. combustion characteristics, effect on performance, emission, cost and safety.

**UNIT V IN CYLINDER AND AFTER TREATMENT TECHNOLOGIES (9)**  
Cylinder Deactivation Technology, Water Injection Technologies. Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction, Ammonia slip / clean up catalyst. CO<sub>2</sub> absorption techniques, Waste Heat Recovery.

**TOTAL: 45 PERIODS**

**Course Outcomes**

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

- CO1: Understand the usage of alcohol in automobiles
- CO2: Know the solar power conversion for the effective usage to automobiles
- CO3: Discuss about bio-diesel and its suitability in off-road vehicles
- CO4: Understand the method using LPG and CNG in automobiles and its performance
- CO5: Identify various about incylinder and after treatment technologies.

**Text Books**

- T1 John Twidell, and Tony Weir. Renewable Energy Sources – 3rd Edition 2015,
- T2 Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines.
- T3 Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers, 2001 - Technology & Engineering,

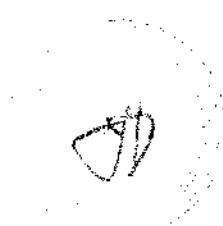
**References**


- R1 Alternative Fuels Guidebook by Bechtold R, SAE International, 1997

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	1	1	1	-	-	-	1	-	-	1	3	2
CO2	3	2	1	1	1	-	-	-	1	-	-	1	3	2
CO3	3	2	1	1	1	-	-	-	1	-	-	1	3	2
CO4	3	2	1	1	1	-	-	-	1	-	-	1	3	2
CO5	3	2	1	1	1	-	-	-	1	-	-	1	3	2
AVG	3	2	1	1	1	-	-	-	1	-	-	1	3	2

  
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**Course Objectives**

1. Master cost reduction techniques and value engineering principles.
2. Learn the value engineering process from information gathering to implementation.
3. Understand product selection and evaluation based on value components.
4. Apply value engineering job plans effectively.
5. Analyze project costs and life cycle expenses efficiently.

**UNIT I VALUE ENGINEERING****(9)**

Introduction to Cost Reduction Techniques, Operation Research, Time and Motion Study, Mass Production Techniques, Standardization, Make-Buy Decision, Simplification, Definition of Value Engineering, Components of Value: Use Value, Exchange Value, Esteem Value, Cost Value, Value Engineering Programme (VEP), Selecting a Product or Service for Study Obtaining and Recording Information, Analyzing Information and Evaluating the Product, Working Out Alternatives, Selecting the Least Cost Alternative, Recommendation and Implementation, Advantages of Value Engineering, Reasons for Unnecessary Costs, Objectives and Reasons for Value Analysis, Concept of Value Engineering, Product Evaluation: Function, Cost, Worth, Cost Evaluation of Alternatives, Areas of Application of Value Engineering

**UNIT II VALUE ENGINEERING JOB PLAN****(9)**

Introduction to value engineering job plan. Orientation phase, Information phase, Function phase, Evaluation of function, Creation Phase, Evaluation phase, Investigation Phase, Development phase, Recommendation Presentation and Implementation Phase.

**UNIT III VALUE ENGINEERING: PROJECT SELECTION AND VALUE STANDARD****(9)**

Value Engineering (VE) Project selection, Methods used for VE project selection, value engineering methodology, Application of VE during Product Dev. Process, Application of Value Engineering during Product Life Cycle, Value standard, Information Phase, Function Analysis Phase, Creation Phase, Evaluation Phase, Development Phase, Presentation Phase.

**UNIT IV FAST DIAGRAM AND LIFE CYCLE COST****(9)**

Introduction, Uses of FAST diagram, Types of FAST diagram, technically oriented FAST diagram, Layout of FAST diagram, Tips for preparing FAST diagram, Customer (Task) oriented FAST diagram, Life Cycle Cost (LCC). Development cost, Direct Material Cost, Direct Labour Cost, General expenses, Factory expenses, Sales expenses, Maintenance and repair cost during service life, Time Value of Money, Evaluation of life cycle cost.

**UNIT V INTRODUCTION****(9)**

VE Level of Effort, Definitions - Value Engineering (VE), Value Analysis (VA). Project Cost, Worth, Value, Function, Basic Function, Secondary function, Higher order function, Required secondary function, Assumed functions, Supporting functions, Function Analysis. FAST diagram, VE Job Plan, VE Project, Life cycle cost

Case study (technically oriented FAST diagram)

Case Study 1: O.H.P.

Case Study 2: Lathe Machine

Case study 3: Air conditioner

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: implement cost reduction techniques and value engineering principles in real-world scenarios.
- CO2: demonstrate proficiency in the value engineering process, from information gathering to implementation, through practical exercises and assessments.
- CO3: develop the skills to evaluate products and services based on their value components, leading to informed decision-making.
- CO4: applying value engineering job plans, students will showcase their ability to systematically analyze and optimize processes and products.
- CO5: equipped to conduct thorough cost analysis, including life cycle expenses, and make data-driven recommendations for improved efficiency and cost-effectiveness.

**Text Books**

- T1 Dr. M. A. Bulsara and Dr. H. R. Thakkar - Product Design And Value Engineering– 2nd Revised and Enlarged Edition : 2015 Charotar Publishing House Pvt. Ltd


T2 Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing". 1st Edition. CRC Press., United States, 2015, ISBN-13: 978-1482223590.

**References**


- R1 Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States ,2006. ISBN: 978-1-4614-9842-1.  
 R2 Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development". CRC Press., United States, 2011, ISBN: 9780849334092.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	3	2	2	3	2	2	2	3	3	2
CO2	3	2	2	3	2	2	2	2	2	3	3	3	3	2
CO3	3	3	2	2	2	1	1	1	1	1	3	3	3	2
CO4	3	3	3	3	2	1	1	1	3	2	3	3	3	2
CO5	3	3	3	3	3	3	3	3	3	3	3	2	3	2
AVG	3	2.8	2.6	2.8	2.4	2.2	2.2	2.2	2.4	2.2	2.8	2.8	3	2

  
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**Course Objectives**

1. Understand the evolution and applications of additive manufacturing technologies.
2. Explore principles and benefits of Design for Additive Manufacturing (DfAM).
3. Gain insight into different additive manufacturing processes and their applications.
4. Learn about additional additive manufacturing processes and their characteristics.
5. Develop proficiency in understanding the AM process chain and design rules for AM.

**UNIT I INTRODUCTION**

(9)

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing Electronics Printing.

**UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DFAM)**

(9)

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization Generative design- Lattice Structures - Multi-Material Parts and Graded Materials – Data Processing: CAD Model Preparation - AM File formats: STL- Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.

**UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION**

(9)

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP) Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications.

**UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION**

(9)

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials -Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.

**UNIT V ADDITIONAL ADDITIVE MANUFACTURING PROCESSES**

(9)

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Apply additive manufacturing technologies effectively in various industries and contexts.  
 CO2: Demonstrate competence in designing for additive manufacturing, optimizing parts for AM processes.  
 CO3: Identify and select appropriate additive manufacturing processes for specific applications.  
 CO4: Evaluate the advantages and limitations of different additive manufacturing techniques.  
 CO5: Synthesize knowledge of additive manufacturing to propose innovative solutions for real-world challenges.

**Text Books**

- T1 Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “Additive manufacturing technologies”. 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0  
 T2 Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

**References**

- R1 Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.  
 R2 Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.

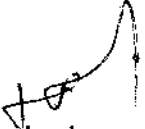
CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
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CO2	3	3	3	1	2	1	1	1	1	2	1	2	3	2
CO3	3	2	3	3	2	2	1	1	1	1	1	2	3	2
CO4	3	3	3	3	3	2	1	1	2	1	1	2	3	2
CO5	3	2	2	2	2	1	1	1	1	1	1	1	3	2
AVG	3	2.8	2.8	2.4	2.6	1.8	1.8	1	1.6	1.2	1.2	2.2	3	2

  
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**Course Objectives**

1. Master CAD tools for 2D drawings and 3D modeling, including constraints and parameters.
2. Develop expertise in CAM processes such as tool selection and toolpath setup for CNC machining.
3. Understand CAD/CAM integration and process planning for efficient manufacturing workflows.
4. Gain proficiency in CNC principles, machine tools, and part programming for machining operations.
5. Explore additive manufacturing technologies and their applications in design validation and rapid tooling.

**UNIT I COMPUTER AIDED DESIGN (CAD) (9)**

Overview of 2D drawings, work area customization, constraints and parameters, sketching tools, geometrical modifications, converting 2D drawings to 3D models, modeling features and tools, dimensioning and annotations, materials and appearances, file import/export.

**UNIT II COMPUTER AIDED MANUFACTURING (CAM) (9)**

Overview of machining processes, work setup, cutting tool selection, calculation of feeds and speeds, CAM cycles, cutting planes selection, toolpath setup, post-processing of G-codes, file import/export.

**UNIT III CAD AND CAM INTEGRATION (9)**

Introduction - Networking - Techniques, components, interface cards, network standards. Graphics standards - Graphical kernel system, Data exchange format - IGES and STEP. Process planning, Computer Aided Process Planning (CAPP), Product life cycle management (PLM), Enterprise resource planning (ERP).

**UNIT IV FUNDAMENTAL OF CNC AND PART PROGRAMMING (9)**

Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools-Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types – Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

**UNIT V ADDITIVE MANUFACTURING (9)**

Rapid Prototyping: Introduction, Classification of RP Processes, Advantages & disadvantages. RP Applications; in Design, Concept Models, Form & fit checking, Functional testing, CAD data verification, Rapid Tooling, and bio fabrication. Working Principle, Application, Advantages & disadvantages: of Stereolithography Apparatus (SLA) Selective Laser Sintering (SLS), 3D Printing, Fused Deposition Modeling (FDM), and Laminated Object Manufacturing (LOM)

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Apply CAD skills to create precise 2D drawings and 3D models.
- CO2: Utilize CAM techniques for CNC machining, including tool selection and toolpath setup.
- CO3: Demonstrate proficiency in CAD/CAM integration and process planning.
- CO4: Execute CNC machining operations proficiently, understanding CNC principles and part programming techniques.
- CO5: Evaluate additive manufacturing processes and their applications for enhanced productivity and innovation.

**Text Books**

- T1 Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill PublishingCo.2007
- T2 Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008
- T3 Radhakrishnan P, Subramanyan S.andRaju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi,2000.

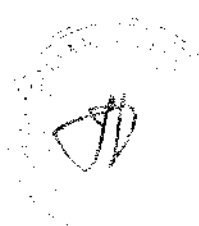
**References**


- R1 Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999.
- R2 Donald Hearn and M. Pauline Baker "Computer Graphics". Prentice Hall, Inc,1992

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	3	2	2	1	3	3	3	3	3	3
CO2	3	3	3	3	3	2	2	1	3	3	3	3	3	3
CO3	3	3	3	3	3	2	1	1	3	3	3	3	3	3
CO4	3	3	3	3	3	2	1	1	3	3	3	3	3	2
CO5	3	3	3	3	3	2	3	1	3	2	2	3	3	2
AVG	3	3	3	3	3	2	2.2	1	3	2.8	2.8	3	3	2.6

  
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**HiCET**

**Course Objectives**

1. Apply the use of sensors for measurement of displacement, force and pressure.
2. Employ commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.
3. Demonstrate the use of virtual instrumentation in automation industries.
4. Identify and use data acquisition methods.
5. Comprehend intelligent instrumentation in industrial automation.

**UNIT I SENSORS & TRANSDUCER****(9)**

Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder. Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

**UNIT II MEASUREMENT OF TEMPERATURE USING THERMISTOR****(9)**

Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

**UNIT III VIRTUAL INSTRUMENTATION****(9)**

Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs, Structures: Case, Sequence & Formula nodes, need of software-based instruments for industrial automation.

**UNIT IV DATA ACQUISITION METHODS****(9)**

Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.

**UNIT V INTELLIGENT SENSORS****(9)**

General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the concept of transduction and methods of extracting information from sensors;  
 CO2: Analyze sensor outputs through the use of analogue circuit concepts;  
 CO3: Understand typical electronic instrumentation for sensors and important concepts such as calibration and references;  
 CO4: Demonstrate knowledge in the state of the art of sensors for a wide range of applications in research and commercial products;  
 CO5: Demonstrate familiarity with a wide range of sensors and instrumentation from electrochemical to optical.

**Text Books**

- T1 DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013  
 T2 D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.  
 T3 S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.  
 T4 Gary Johnson / Lab VIEW Graphical Programming II Edition / McGraw Hill 1997.

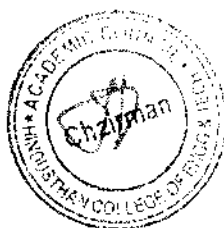
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- R1 Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.  
 R2 A.D. Helfrick and W.D. cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI, 2001  
 R3 Hermann K.P. Neubert, "Instrument Transducers" 2nd Edition 2012, Oxford University Press.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	1	3	2	1	3	1	2	2	3	-	2	2	2
CO2	3	1	2	2	1	3	1	2	2	3	-	2	2	2
CO3	3	2	1	2	1	2	1	1	2	3	-	2	2	2
CO4	3	1	1	1	2	3	1	1	1	3	-	1	2	2
CO5	2	1	2	2		3	1	2	2	3	-	1	1	1
AVG	2.8	1.2	1.8	1.8	1.4	2.8	1	1.6	1.8	3	-	1.6	1.8	1.8

  
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**Course Objectives**

1. To familiarize a relay and power semiconductor devices.
2. To get a knowledge on drive characteristics.
3. To obtain the knowledge on DC motors and drives.
4. To obtain the knowledge on AC motors and drives.
5. To obtain the knowledge on Stepper and Servo motor

**UNIT I RELAY AND POWER SEMI-CONDUCTOR DEVICES****(9)**

Study of Switching Devices – Relay and Types. Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit -Introduction to Driver and snubber circuits.

**UNIT II DRIVE CHARACTERISTICS****(9)**

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.

**UNIT III DC MOTORS AND DRIVES****(9)**

DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

**UNIT IV AC MOTORS AND DRIVES****(9)**

Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.

**UNIT V STEPPER AND SERVO MOTOR****(9)**

Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servomotor – Applications.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Recognize the principles and working of relays, drives and motors.  
 CO2: Explain the working and characteristics of various drives and motors.  
 CO3: Apply the solid-state switching circuits to operate various types of Motors and Drivers  
 CO4: Interpret the performance of Motors and Drives.  
 CO5: Suggest the Motors and Drivers for given applications.

**Text Books**

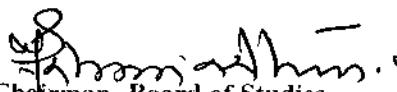
- T1 Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.  
 T2 Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2016.

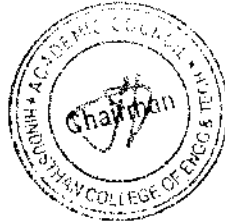
**References**

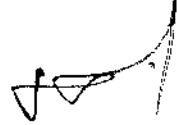
- R1 Theraja B.L. & Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2012.  
 R2 Gopal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.  
 R3 Singh M.D. & Kanchandhani K.B., "Power Electronics". McGraw Hill, New Delhi, 2007

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	1	2	1	1	2	1	1	3	3	-	3	3	2
CO2	2	1	1	2	1	2	1	1	3	3	-	3	3	2
CO3	2	1	1	2	1	2	1	1	3	3	-	3	3	2
CO4	2	2	2	2	2	2	1	1	3	3	-	1	3	2
CO5	2	2	2	2	1	3	1	2	2	3	-	1	3	1
AVG	2	1.4	1.6	1.8	1.2	2.2	1	1.2	2.8	3	-	2.2	3	1.8

  
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**Course Objectives**

1. To familiarize the architecture and fundamental units of microcontroller.
2. To know the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols.
3. To design the interface circuit and programming of I/O devices, sensors and actuators.
4. To understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems.
5. To acquaint the knowledge of real time embedded operating system for advanced system developments.

**UNIT I INTRODUCTION TO MICROCONTROLLER (9)**

Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization - Instruction Sets – Addressing Modes.

**UNIT II PROGRAMMING AND COMMUNICATION (9)**

Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming - Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller.

**UNIT III PERIPHERAL INTERFACING (9)**

I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light.

**UNIT IV ARM PROCESSOR (9)**

Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 - Applications.

**UNIT V SINGLE BOARD COMPUTERS AND PROGRAMMING (9)**

System on Chip - Broadcom BCM2711 SoC – SBC architecture - Models and Languages – Embedded Design – Real Time Embedded Operating Systems - Real Time Programming Languages – Python for Embedded Systems- GPIO Programming – Interfacing.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Know the various functional units of microcontroller, processors and system-on-chip based on the features and specifications.
- CO2: Recognize the role of each functional units in microcontroller, processors and system- on chip based on the features and specifications.
- CO3: Interface the sensors, actuators and other I/O's with microcontroller, processors and system on chip based interfacing
- CO4: Design the circuit and write the programming microcontroller, processors and system on chip
- CO5: Develop the applications using Embedded system.

**Text Books**

- T1 Frank Vahid and Tony Givagis, “Embedded System Design”, 2011, Wiley.
- T2 Kenneth J. Aylala, “The 8051 Microcontroller, the Architecture and Programming Applications”, 2003.

**References**

- R1 Muhammad Ali Mazidi and Janice GillispieMazdi, “The 8051 Microcontroller and Embedded Systems”, Pearson Education, 2006.
- R2 Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition, 2015
- R3 James W. Stewart, “The 8051 Microcontroller Hardware, Software and Interfacing”, Regents Prentice Hall, 2003.
- R4 John B. Peatman, “Design with Microcontrollers”, McGraw Hill International, USA, 2005.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	2	2	2	1	2	2	3	-	1	3	1
CO2	3	3	3	2	2	2	1	2	2	3	-	1	3	1
CO3	3	3	3	2	2	2	1	2	2	3	-	1	3	1
CO4	3	2	3	2	2	2	1	2	1	3	-	1	3	1
CO5	3	3	3	1	2	2	1	2	2	3	-	1	3	1
AVG	3	2.8	2.8	1.8	2	2	1	2	1.8	3	-	1	3	1

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**HICET**

**Course Objectives**

1. To study the various aspects of digital manufacturing
2. To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management.
3. To formulate of smart manufacturing systems in the digital work environment.
4. To interpret IoT to support the digital manufacturing.
5. To elaborate the significance of digital twin.

**UNIT I INTRODUCTION**

(9)

Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – The Future of Digital Manufacturing.

**UNIT II DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT**

(9)

Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, – Digital Mock up and Prototype development. Overview of Digital Supply Chain – Scope & Challenges in Digital SC - Future Practices in SCM

**UNIT III SMART FACTORY**

(9)

Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity

**UNIT IV INDUSTRY 4.0**

(9)

Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems – Case Studies.

**UNIT V STUDY OF DIGITAL TWIN**

(9)

Basic Concepts – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Impart knowledge to use various elements in the digital manufacturing.
- CO2: Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment.
- CO3: Select the proper procedure of validating practical work through digital validation in Factories.
- CO4: Implementation the concepts of IoT and its role in digital manufacturing.
- CO5: Analyse and optimize various practical manufacturing process through digital twin

**Text Books**

- T1 Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.
- T2 Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.

**References**

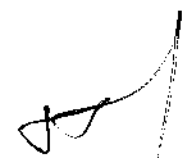
- R1 Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
- R2 Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
- R3 Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
- R4 Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.

### CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	-	1	1	3	3	-	1	2	2	-	2	3	2
CO2	3	2	3	1	3	3	2	2	2	2	-	2	3	2
CO3	3	-	3	1	3	3	2	-	3	2	-	2	3	2
CO4	3	2	2	2	3	3	2	2	2	2	2	2	3	2
CO5	3	-	2	-	1	3	-	2	2	2	-	2	3	2
AVG	3	2	2.2	1.25	2.6	3	2	1.75	2.2	2	2	2	3	2

  
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 Dean – Academics

**Course Objectives**

1. To introduce the basics of 6 SIGMA
2. To learning about the lean manufacturing tools.
3. To study about the deeper understanding methodologies of Lean manufacturing.
4. To study the lean concepts and its elements.
5. To learn implementation and challenges of lean manufacturing.

**UNIT I BASICS OF 6 SIGMA****(9)**

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, Mean and moving the mean, Various quality costs, cost of poor quality.

**UNIT II INTRODUCTION TO LEAN MANUFACTURING TOOLS****(9)**

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP, foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements.

**UNIT III DEEPER UNDERSTANDING METHODOLOGIES****(9)**

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System.

**UNIT IV LEAN ELEMENTS****(9)**

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost.

**UNIT V IMPLEMENTATION AND CHALLENGES****(9)**

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Discuss the basics of 6 SIGMA  
 CO2: Elaborate the lean manufacturing tools.  
 CO3: Illustrate about the deeper understanding methodologies of Lean manufacturing.  
 CO4: Discuss lean concepts and its elements.  
 CO5: Describe the implementation and challenges of lean manufacturing.

**Text Books**

- T1 Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill  
 T2 Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia  
 T3 The Toyota Way: 14 Management Principles  
 T4 Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy, Masaki Imai

**References**

- R1 Quality Council of India <https://qcin.org/> & its library. [https://qcin.org/nbqp/knowledge\\_bank/](https://qcin.org/nbqp/knowledge_bank/)  
 R2 International Society of Six Sigma Professionals: <https://isspp.org/about-us/>  
 R3 NPTEL / SWAYAM: <https://nptel.ac.in/courses/110105123> : Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning).  
 R4 Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.  
 R5 Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO2	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO3	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO4	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO5	1	1	2	1	1	-	-	-	1	-	3	1	1	2
AVG	1	1	2	1	1	-	-	-	1	-	3	1	1	2

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**HICET**

**Course Objectives**

1. To introduce definition, history of robotics and robot anatomy.
2. To learn the simulation of robot kinematics
3. To study the grasping and manipulation of robots.
4. To study about mobile robot and manipulation.
5. To study the applications of industrial, service, domestic robots.

**UNIT I INTRODUCTION (9)**

Robot: Definition, History of Robotics, Robot Anatomy, Co-ordinate systems, types and classification, Configuration space and degrees of freedom of rigid bodies and robots, Configuration space topology and representation; configuration and velocity constraints; Rigid-body motions, rotation matrices, angular velocities, and exponential coordinates of rotation.

**UNIT II SIMULATION OF ROBOT KINEMATICS (9)**

Robot kinematics, Forward and inverse kinematics (two three four degrees of freedom), Forward and inverse kinematics of velocity, Homogeneous transformation matrices, Dynamics of Open Chains, Trajectory Generation, motion planning, robot control: First- and second-order linear error dynamics, stability of a feedback control system.

**UNIT III GRASPING AND MANIPULATION OF ROBOTS (9)**

Kinematics of contact, contact types (rolling, sliding, and breaking), graphical methods for representing kinematic constraints in the plane, and form-closure grasping, End effectors, grippers, types of gripper, gripper force analysis, and examples of manipulation and grasping.

**UNIT IV MOBILE ROBOTS (9)**

Mobile robot, Wheeled Mobile Robots: Kinematic models of omnidirectional and non-holonomic wheeled mobile robots, Controllability, motion planning, feedback control of non-holonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation.

**UNIT V APPLICATIONS OF ROBOTS (9)**

Application of robotic: industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Discuss the definition, history of robotics and robot anatomy.  
 CO2: Develop the simulation of robot kinematics  
 CO3: Describe the grasping and manipulation of robots.  
 CO4: Explain about mobile robot and manipulation.  
 CO5: Discuss the applications of industrial, service, domestic robots.

**Text Books**

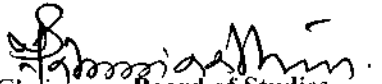
- T1 Modern Robotics: Mechanics, Planning, and Control, by Kevin M. Lynch , Frank C. Park , Cambridge University Press; 1st edition (25 May 2017), ISBN-10 : 110715  
 T2 Modern Robotics: Mechanics, Systems and Control, by Julian Evans, Larsen and Keller Education (27 June 2019), ISBN-10 : 1641720751

**References**


- R1 Modern Robotics: Designs, Systems and Control, by Jared Kroff, Willford Press (18 June 2019) ISBN-10 : 1682856763  
 R2 Advanced Technologies in Modern Robotic Applications, by Chenguang Yang , Hongbin Ma , Mengyin Fu, Springer; Softcover reprint of the original 1st ed. 2016 edition (30 May 2018), ISBN- 10 : 981109263X  
 R3 Modern Robotics: Building Versatile Machines, by Harry Henderson, Facts On File Inc; Illustrated edition (1 August 2006), ISBN-10 : 0816057451  
 R4 Artificial Intelligence for Robotics, by Francis X. Govers, Packt Publishing Limited; Standard Edition (30 August 2018), ISBN-10 : 1788835441  
 R5 Modern Robotics Hardcover by Lauren Barrett (Editor), Murphy & Moore Publishing (1 March 2022), ISBN-10 : 1639873732

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	1	3	1	2	-	-	-	1	-	-	1	1	2
CO2	2	1	3	1	2	-	-	-	1	-	-	1	1	2
CO3	2	1	3	1	2	-	-	-	1	-	-	1	1	2
CO4	2	1	3	1	2	-	-	-	1	-	-	1	1	2
CO5	2	1	3	1	2	-	-	-	1	-	-	1	1	2
AVG	2	1	3	1	2	-	-	-	1	-	-	1	1	2

  
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**Course Objectives**

1. To elucidate on biomass, types, availability, and characteristics
2. To study the bio-methanation process.
3. To impart knowledge on combustion of bio-fuels
4. To describe on the significance of equivalence ratio on thermo-chemical conversion of biomass
5. To provide insight to the possibilities of producing liquid fuels from biomass

**UNIT I INTRODUCTION**

(9)

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies.

**UNIT II BIOMETHANATION**

(9)

Biomehanation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.

**UNIT III COMBUSTION**

(9)

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion

**UNIT IV GASIFICATION, PYROLYSIS AND CARBONISATION**

(9)

Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonization.

**UNIT V LIQUIFIED BIOFUELS**

(9)

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Estimate the surplus biomass availability of any given area.  
 CO2: Design a biogas plant for a variety of bio-fuels.  
 CO3: Determine and compare the cost of steam generation from bio-fuels with that of coal and petroleum fuels.  
 CO4: Analyse the influence of process governing parameters in thermo-chemical conversion of biomass.  
 CO5: Synthesize liquid bio-fuels for power generation from biomass.

**Text Books**

- T1 Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar, Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10 : 0367745550  
 T2 Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni, Solomon U. Oranusi, Springer (30 June 2022).

**References**

- R1 Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S  
 E2 Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication, 1997  
 R3 David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester, 1984.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	-	-	-	2	-	3	-	1	-	-	2	2	-
CO2	2	2	3	-	-	2	2	-	-	-	-	2	2	2
CO3	2	2	3	2	-	-	1	-	-	-	2	2	2	1
CO4	2	2	3	2	-	-	1	-	-	-	2	2	2	1
CO5	2	2	3	2	-	-	1	-	-	-	2	2	2	2
AVG	2	2	3	2	2	2	1.6	-	1	-	2	2	2	1.5

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**HICET**



**Course Objectives**

1. To clarify impression of various solar thermal energy collectors
2. To identify with the various process of solar heating systems
3. To outline the various types of solar cooling system
4. To delineate the other applications and the devices used to collect solar energy
5. To summarize the basic economics of solar energy collection system

**UNIT I SOLAR COLLECTORS**

(9)

Flat plate - Evacuated tube – Concentrated - Pool and Air collectors Construction – Function - Suitability – Comparison - Storage Tank - Solar Fluids

**UNIT II SOLAR WATER HEATING SYSTEMS**

(9)

Integral Collector Storage System- Thermosyphon System - Open Loop, Drain Down, Drain Back, Antifreeze Systems - Refrigerant Solar Water Heaters - Solar Heated Pools - Solar Heated Hot Tubs and Spas

**UNIT III SOLAR SPACE CONDITIONING SYSTEMS**

(9)

Liquid Type Solar Heating System With / Without Storage - Heat Storage Configurations – Heat Delivery Methods - Air-Type Solar Heating Systems - Solar Refrigeration and Air Conditioning

**UNIT IV OTHER SOLAR APPLICATIONS**

(9)

Solar Cooking – Distillation - Desalination - Solar Ponds – Solar Passive Architecture – Solar Drying – Solar Chimney.

**UNIT V SOLAR ECONOMICS**

(9)

Application of economic methods to analyze the feasibility of solar systems to decide project / policy alternatives - Net energy analysis - and cost requirements for active and passive heating and cooling - for electric power generation - and for industrial process-heating

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: The impression of various solar thermal energy collectors were clarified.  
 CO2: Explicate the spectrum of possible water heating system to assist the industrial process  
 CO3: Articulate the technical and economic viability of solar cooling systems  
 CO4: The other applications and the devices used to collect solar energy were incorporated.  
 CO5: The basic economics of solar energy collection system was understood.

**Text Books**

- T1 Soteris A. Kalogirou, "Solar Energy Engineering Processes and Systems", Academic Press, 2014  
 T2 S. P. Sukhatme, J K. Nayak, "Solar Energy", McGraw Hill, New Delhi, 2017, Fourth Edition.

**References**


- R1 HP Garg and J Prakash, "Solar Energy: Fundamentals and Applications", Tata McGraw Hill, 2010  
 E2 John A. Duffie and William A. Beckman, "Solar Engineering of Thermal Processes", Wiley, 2013  
 R3 Bob Ramlow & Benjamin Nusz, Solar Water Heating, New Society Publishing, 2010

CO PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	-	3	2	3	-	1	-	-	-	1	2	2	1
CO2	2	-	3	-	3	-	1	-	-	-	2	2	2	1
CO3	2	-	3	-	3	-	1	-	-	-	2	2	2	1
CO4	2	-	3	-	3	-	2	-	-	-	2	2	2	1
CO5	2	-	3	2	3	-	1	-	-	-	1	2	2	1
AVG	2	-	3	-	3	-	1.2	-	-	-	1.6	2	2	1

  
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**Course Objectives**

1. To learn Quantifying the energy demand and energy supply scenario of nation and explaining the need for energy auditing for becoming environmentally benign
2. To Analyzing factors behind energy billing and applying the concept of demand side management for lowering energy costs
3. To learn Computing the stoichiometric air requirement for any given fuel and quantifying the energy losses associated with thermal utilities of industries
4. To Diagnosing the causes for under performance of various electrical utilities and suggesting remedies for improving their efficiency
5. To Applying CUSUM and other financial evaluation techniques to estimating the accruable energy savings/monetary benefits for any energy efficiency project

**UNIT I INTRODUCTION**

(9)

Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.

**UNIT II ELECTRICAL SUPPLY SYSTEMS**

(9)

Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor –Energy conservation in Transformers – Harmonics

**UNIT III ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES**

(9)

Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices

**UNIT IV ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES**

(9)

Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems

**UNIT V ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS**

(9)

Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling – Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept – PAT scheme

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Discuss Quantify the energy demand and energy supply scenario of nation and appreciate the need for energy auditing for becoming environmentally benign
- CO2: Analyse factors behind energy billing and apply the concept of demand side management for lowering energy costs
- CO3: Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries
- CO4: Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency
- CO5: Apply CUSUM and other financial evaluation techniques to estimate the accruable energy savings/monetary benefits for any energy efficiency project

**Text Books**

- T1 Guide book for National Certification Examination for “Energy Managers and Energy Auditors” (4 Volumes). Available at <http://www.em-ea.org/gbook1.asp>. This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India. 2015
- T2 K. Nagabhushan Raju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers & Dist, 2007.

**References**

- R1 Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006.
- E2 Albert Thumann and Paul Mehta D, “Handbook of Energy Engineering”, 7th Edition, The Fairmont Press, 2013
- R3 Steve Doty, Wayne Turner C, Energy Management Handbook 7th Edition, The Fairmont Press, 2009

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	-	-	-	3	-	1	-	-	1	2	2
CO2	2	2	1	-	-	-	3	-	1	-	-	1	2	2
CO3	2	2	1	-	-	-	3	-	1	-	-	1	2	2
CO4	2	2	1	-	-	-	3	-	1	-	-	1	2	2
CO5	2	2	1	-	-	-	3	-	1	-	-	1	2	2
AVG	2	2	1	-	-	-	3	-	1	-	-	1	2	2

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**Course Objectives**

1. To learn the constructional and design features of an automobile chassis and frames.
2. To know about the various functional features of an automotive front axle and steering system.
3. To comprehend the functions of various driveline components.
4. To understand the constructional features and working of automotive suspension systems.
5. To gain knowledge about the functionality of braking system, wheels, tyres and their constructional details.

**UNIT I CHASSIS AND FRAMES****(8)**

Chassis – basic construction – types of Chassis layout – based on powertrain – Frames – types – various loads acting on vehicle frame – Vehicle body design details.

**UNIT II FRONT AXLE AND STEERING SYSTEM****(9)**

Axle – types of front and stub axles – wheel geometry – true rolling motion – Ackerman's and Davis steering mechanisms – steering linkages – different types of steering gear boxes – slip angle – over steer and under steer – reversible and irreversible steering – power steering.

**UNIT III DRIVELINE, FINAL DRIVE AND REAR AXLE****(10)**

Driveline – thrust effects – torque reactions – side thrust – Propeller shaft – universal joints – final drive – differential – constructional details – functions – types – non slip differential – differential locks – rear axles – construction – types – twist beam rear axle – various loads acting on rear axles.

**UNIT IV SUSPENSION SYSTEMS****(9)**

Suspension systems – need – constructional details and characteristics of single leaf, multi-leaf spring, coil and torsion bar springs – rubber, pneumatic and hydro elastic suspension spring systems – independent suspension system – shock absorbers – radius rods – stabilizer bar.

**UNIT V BRAKING SYSTEMS, WHEELS AND TYRES****(9)**

Brakes – need – classification – drum and disc brakes – hydraulic, mechanical, pneumatic braking systems – power assisted braking system – servo brakes – braking parameters – Wheels – functions – types – balancing – rims – constructional details – types – Tyres – classification – constructional details – maintenance.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Know about the design details of chassis.  
 CO2: Infer about the principles and working of automotive steering and front axle system.  
 CO3: Understand about the driveline, final gearing and rear axle system and its troubleshooting.  
 CO4: Analyze the various design features and parameters of an automotive suspension system.  
 CO5: Illustrate the problems arising in the braking system, wheels and tyres.

**Text Books**

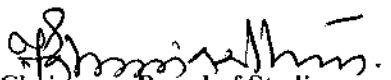
- T1 Kirpal Singh, "Automobile Engineering – Volume 1", Standard Publishes-Distributors, Delhi, 2012.  
 T2 R.K. Rajput, "A Textbook of Automobile Engineering", Laxmi Publications Private Limited, 2007.  
 T3 N.K. Giri, "Automotive Mechanics" Khanna Publishers, New Delhi, 2005.

**References**

- R1 Heldt P.M., "Automotive Chassis", 2012, Literary Licensing, LLC  
 R2 Newton Steeds and Garret, "Motor Vehicles" 13<sup>th</sup> Edition, Butterworth, London, 2005.  
 R3 Heinz Hazler, "Modern Vehicle Technology", Butterworth, London, 2005.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	1	2	-	-	3	-	-	2	-	3	2	2
CO2	3	3	3	2	-	-	3	-	-	2	-	3	2	2
CO3	3	3	3	1	2	-	2	-	-	2	-	3	2	3
CO4	3	2	2	2	2	2	2	-	-	2	-	2	2	2
CO5	3	2	3	2	2	3	2	-	-	2	-	2	2	2
AVG	3	2.6	2.4	1.8	2	2.5	2.4	-	-	2	-	2.6	2	2.2

  
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**Course Objectives**

1. To compare types of Clutches and Gear Box, its principle and applications.
2. To understand the construction, principle and the concept of Fluid Coupling & Torque Converter
3. To define the various transmission and drive line units of automobiles
4. To demonstrate the various types of hydrostatic and electric drives
5. To list out the applications of automatic transmission

**UNIT I CLUTCH AND GEAR BOX**

(9)

Requirement of transmission system –Types of clutches–Principle & Construction of Single plate, Diaphragm, Multi Plate, Centrifugal, Semi-Centrifugal and Dual Clutch–Gear box–Construction and operation–Sliding mesh, Constant mesh and Synchromesh gearboxes– Determination of gearratios, Tractive effort, Engine speed & Power and acceleration.

**UNIT II FLUID COUPLING AND TORQUE CONVERTORS**

(9)

Fluid coupling–Principle–Constructional details–Torque capacity–Performance characteristics–Reduction of drag torque in fluid coupling–Torque converter–Principle–constructional details, performance characteristics–Multistage torque converters and Polyphase torque converters.

**UNIT III EPICYCLIC GEARBOXES**

(9)

Principle of Planetary gear trains - Wilson Gear box -- Cotal electromagnetic transmission - Hydraulic control system for Automatic Transmission.

**UNIT IV HYDROSTATIC AND ELECTRIC DRIVE**

(9)

Hydrostatic drive- Various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive– construction and working of typical Janny hydrostatic drive– Electric drive-types- Principle of early and modified Ward Leonard Control system-Advantages & limitations

**UNIT V AUTOMATIC TRANSMISSION APPLICATIONS**

(9)

Automatic transmission– merits and demerits–Four speed longitudinally mounted automatic transmission–Chevrolet turbo glide transmission–ZF gear box–Electronically Controlled Transmission– CVT-Types, Operation

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Classify the constructional, working principle of various types of manual and automotive transmission of an automobile.
- CO2: Explain the advantages of automatic transmission over the conventional systems
- CO3: Build a proper transmission system for a vehicle
- CO4: Identify and solve problems related to transmission system.
- CO5: Summarize the application of automatic transmission in automobile industry

**Text Books**

- T1 Heldt, P.M., Torque converters, Chilton Book Co., 1962.
- T2 Newton and Steeds, Motor vehicles, Illiffe Publishers, 1985.
- T3 Judge, A.W., Modern Transmission systems, Chapman and Hall Ltd., 1990

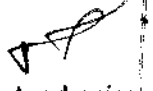
**References**

- R1 SAE Transactions 900550 & 930910.
- R2 Hydrostatic transmissions for vehicle applications, I Mech E Conference, 1981-88.
- R3 Crouse, W.H., Anglin, D.L., Automotive Transmission and Power Trains construction, McGraw Hill, 1976.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	1	2	-	-	3	-	-	2	-	3	3	2
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CO4	3	2	2	2	2	2	2	-	-	2	-	2	3	2
CO5	3	2	3	2	2	3	2	-	-	2	-	2	3	2
AVG	3	2.6	2.4	1.8	2	2.5	2.4	-	-	2	-	2.6	3	2.2

  
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**Course Objectives**

1. Students able to know about the types of alternative fuels and energy sources for IC engines.
2. To impart the knowledge in the field of engine modification based on the alternative fuel.
3. To build the students to familiar in electric and hybrid vehicles.
4. To acquire knowledge in the field of production methods of alternative fuels
5. To learn about safety precaution for production and storing of alternative fuels

**UNIT I ALCOHOLS AS FUELS**

(9)

Alternative fuels-Introduction-Need-Availability of different alternative fuels for SI and CI engines-Alcohols as fuels-Production-Properties-Methods of using alcohols in CI and SI engines-Blending-dual fuel operation-surface ignition and oxygenated additives-Performance emission and combustion characteristics in CI and SI engines.

**UNIT II VEGETABLE OILS AS FUELS**

(9)

Various vegetable oils and their properties-methods of using vegetable oils engines-Blending- preheating- Transesterification- emulsification-Performance-Emission-Combustion Characteristics in diesel engines.

**UNIT III HYDROGEN AS ENGINE FUEL**

(9)

Hydrogen-Production-Combustive properties-Problems associated with hydrogen as fuel-solutions-methods of using hydrogen in SI and CI engines-Performance-emission-combustion analysis in engines-storage-safety aspects.

**UNIT IV BIOGAS, NATURAL GAS AND LPG AS FUELS**

(9)

Biogas, Natural gas and LPG-Production-Properties-CO<sub>2</sub>-H<sub>2</sub>S scrubbing. Modification required to use in SI and CI Engines-Performance-emission characteristics of Biogas-NG and LPG in SI and CI engines.

**UNIT V ELECTRIC, HYBRID AND FUEL CELL VEHICLES**

(9)

Electric vehicle and Hybrid vehicles-Layout-Advantages and drawbacks-system components- Electronic control system- Different configurations of Hybrid vehicles-Power split device-High energy and power density batteries-Basics of Fuel cell vehicles-Solar powered vehicles.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: On completion of the course, the student will understand the various alternative fuels available and their properties  
 CO2: Apply knowledge in engine modifications required for performance, combustion, emission characteristics.  
 CO3: Students will be familiar in alternative sources for propulsion of vehicle  
 CO4: Develop new alternative source for propulsion of vehicle  
 CO5: Be familiar in renewable energy resources

**Text Books**

- T1 Dr. G. Devaradjane., Dr. M. Kumaresan., "Automobile Engineering", AMK Publishers, 2013.  
 T2 Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008, ISBN-13: 9781846289941

**References**

- R1 Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook. AOCS Press Champaign, Illinois 2005.  
 R2 Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	-	-	3	-	-	2	-	3	3	2
CO2	3	3	3	2	-	-	3	-	-	2	-	3	3	2
CO3	3	3	3	1	2	-	2	-	-	2	-	3	3	3
CO4	3	2	2	2	2	2	2	-	-	2	-	2	3	2
CO5	3	2	3	3	2	3	2	-	-	2	-	2	3	2
AVG	3	2.6	2.6	2.2	2	2.5	2.4	-	-	2	-	2.6	3	2.2

  
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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech.	22AU5601	AUTOMOTIVE ENGINES	3	0	0	3

### Course Objective

- To impart knowledge on various engine components and working cycles
- To acquire knowledge in injection and ignition system
- To understand the combustion process in SI and CI engines
- To understand the requirements of cooling and lubrication systems.
- To identify the nature of pollutant formation and control techniques

#### UNIT I INTERNAL COMBUSTION ENGINES FUNDAMENTALS (9)

Engine types and their operation - classifications – Terminology- Four stroke and two stroke cycle Engine components, working principle and materials - Engine operating parameters- Engine cycles- Air Standard cycles- Otto cycle- Fuel – air and actual cycle analysis – Engine emissions – Two stroke engine terminology – types – Merits and Demerits

#### UNIT II INJECTION AND IGNITION SYSTEMS (9)

Diesel fuel injection systems-types-Function- Fuel Injection Pump, Jerk distributor, mechanical and Pneumatic speed governor-Fuel Injector-Types of nozzle-CRDI.Air fuel ratio–Carburetion–types of Carburetor-Spark plug-Ignition Systems–battery coil- magneto coil-Electronic type-Petrol injection system-MPFI

#### UNIT III COMBUSTION AND COMBUSTION CHAMBERS (9)

Stages of combustion in SI engines, Factors affecting ignition delay and flame propagation, Abnormal combustion-knocking, control of knock, octane rating of SI engine fuel, Combustion chambers for SI engines, Stages of combustion in CI engines- factors affecting ignition delay, CI engine knock, cetane rating of CI engine fuel, - importance of swirl, squish and turbulence in CI engines..

#### UNIT IV COOLING AND LUBRICATION SYSTEMS (9)

Need for cooling, Effects of over cooling, Air and liquid cooling systems- thermo siphon, forced circulation and pressure cooling systems, components liquid cooling system, Requirements of coolants anti freezing agents, Requirements of lubrication system, Types- mist, pressure feed, dry and wet sump systems

#### UNIT V ENGINE PERFORMANCE AND EMISSION STANDARD (9)

Indicated power, Brake power, Engine Torque ,Mechanical Efficiency, Air standard Efficiency -Emissions-Types-CO,HC,NOx,SO2 - Emission control measures for IC engines, Barot Stage (BS) & Norms, BS - I,II,III,IV&VI Engines-Effect of emissions on environment and human beings.

**Total Instructional Hours 45**

### Course Outcome

Upon completion of the course, students will be able to

CO1: Illustrate the fundamental concepts and functions of an automotive engine and working cycles.

CO2: Identify the type of injection and ignition systems.

CO3: Differentiate spark ignition and compression ignition combustion chambers used in automotive engines.

CO4: Select appropriate cooling system for automobile engines..

CO5: Apply the knowledge to measure the pollution and control.

### TEXT BOOKS:

T1 John B.Heywood , “ Internal Combustion Engines” , McGraw - Hill Book Company

T2 M.L. Mathur and R.P.Sharma, Internal Combustion Engine, Dhanpath Rai Publications (P) Ltd, New Delhi

T3 V. Ganesan. Internal Combustion Engines, Tata - McGraw Hill Publishing Co., New Delhi

### REFERENCE BOOKS:

R1 K. K. Ramalingm, Internal Combustion Engines, Scitech publications, Chennai, 2003.

R2 Heldt, P.M., High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta

R3 Obert, E.F., Internal Combustion Engine analysis and Practice, International Text Book Co.,Scranton,Pennsylvania, 1988.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	3	3	3	-	-	2	-	3	3	2
CO2	3	3	2	2	2	2	2	-	-	2	-	2	3	3
CO3	2	2	-	3	3	3	3	-	-	2	-	3	2	2
CO4	2	2	2	2	2	2	2	-	-	2	-	2	2	2
CO5	3	3	2	2	3	2	2	-	-	2	-	2	3	3
AVG	2.6	2.4	2	2.4	2.6	2.4	2.4	-	-	2	-	2.4	2.6	2.4

*S. Srinivasulu Reddy*  
 Chairman, Board of Studies  
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**Course Objectives**

1. To learn the concept of Electric and Hybrid Vehicles, including architectures, modeling, sizing, sub system design and hybrid vehicle control.
2. To Understand about dynamics characteristics of Electric vehicles.
3. To learn the requirement of energy storage devices in Electric vehicles.
4. To study about the suitable electric propulsion systems
5. To understand vehicle networking and energy management system.

**UNIT I NEED FOR ALTERNATIVE SYSTEM (9)**

Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles.

**UNIT II DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES (9)**

Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems.

**UNIT III ENERGY SOURCES (9)**

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

**UNIT IV MOTORS AND CONTROLLERS (9)**

Types of Motors, Characteristic of DC motors, AC single phase and 3-phase motor, PM motors, switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/DC converters.

**UNIT V ENERGY MANAGEMENT SYSTEMS (9)**

Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Summarize the electric and hybrid vehicle operation and architectures.
- CO2: Design and develop dynamics characteristics of Electric vehicles.
- CO3: Demonstrate the energy requirement for vehicles
- CO4: Model and simulate the vehicle characteristics, operating modes, and performance parameters of the vehicle
- CO5: Learn the concept of vehicle networking and energy management system.

**Text Books**

- T1 Iqbal Husain, "Electric and Hybrid Vehicles-Design Fundamentals", CRC Press, 2003
- T2 Mehrdad Ehsani, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press, 2005.

**References**

- R1 Sandeep Dhameja, "Electric Vehicle Battery Systems" NEWNES, 2002
- R2 James Larminie and John Lowry, "Electric Vehicle Technology Explained" John Wiley & Sons, 2003
- R3 Ron Hodkinson, "Light Weight Electric/Hybrid Vehicle Design", Butterworth Heinemann Publication, 2005

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	2	3	3	-	-	-	2	-	3	3	2
CO2	3	2	2	2	3	3	2	-	-	2	-	3	3	2
CO3	2	3	2	2	2	3	-	-	-	2	-	2	3	3
CO4	2	3	2	2	2	2	-	-	-	2	-	2	3	3
CO5	3	2	2	2	2	3	-	-	-	2	-	2	3	3
AVG	2.4	2.4	2	2	2.4	2.8	2	-	-	2	-	2.4	3	2.6

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 Chairman, Board of Studies  
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**AUTO - HICET**



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**Dean (Academics)**  
**HICET**

Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech.	22AU5205	<b>AUTOMOTIVE PRODUCT DESIGN AND DEVELOPMENT</b>	3	0	0	3

- Course Objective**
- To understand Product development and customer need.
  - To learn the Concept Generation and Selection in Product Design
  - To provide a knowledge about product architecture.
  - To learn about industrial design
  - To study the design for manufacturing and product development

Unit	Description	Instructional Hours
	<b>INTRODUCTION</b>	
I	Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.	3
	<b>CONCEPT GENERATION AND SELECTION</b>	
II	Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.	9
	<b>PRODUCT ARCHITECTURE</b>	
III	Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.	9
	<b>INDUSTRIAL DESIGN</b>	
IV	Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.	9
	<b>DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT</b>	
V	Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.	9
	<b>Total Instructional Hours</b>	<b>45</b>

- Course Outcome**
- Upon completion of the course, students will be able to
- CO1: Develop the Product development based on customer need.
  - CO2: Make use of the knowledge in product design and development
  - CO3: knowledge about product architecture.
  - CO4: Use of Smart tools for product development
  - CO5: Economic project planning development

**TEXT BOOKS:**

T1 - Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.1999


**REFERENCE BOOKS:**

R1 - Concurrent Engg./Integrated Product Development. Kemmeth Crow, DRM Associates. 6/3.ViaOlivera. Palos Verdes. CA 90274(310) 377-569,Workshop Book


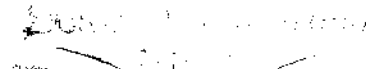
R2 - Effective Product Design and Development. Stephen Rosenthal. Business One Orwin, Homewood, 1992.ISBN, 1-55623-603-4

**CO PO MAPPING**

CO:PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	2	3	3	-			2	-	3	3	2
CO2	3	2	2	2	3	3	2			2	-	3	3	2
CO3	2	3	2	2	2	3	-			2	-	2	3	3
CO4	2	3	2	2	2	2	-			2	-	2	3	3
CO5	3	2	2	2	2	3	-			2	-	2	3	3
AVG	2.4	2.4	2	2	2.4	2.8	2	-	-	2	-	2.4	3	2.6

  
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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech.	22AU5204	COMPOSITE STRUCTURE	3	0	0	3

- Course Objective**
- To Provide students with a basic understanding of the composition and uses of composite materials, their structural and mechanical properties
  - To learn about the manufacturing of various types composite materials.
  - To provide an knowledge about joining of composite materials products.
  - To learn about mordent materials used for automobiles.
  - To study the various types of smart materials and its applications.

Unit	Description	Instructional Hours
I	<b>INTRODUCTION</b> Definitions -Composites, Multiscale Composites and Nano composites, Reinforcements and Matrices, Properties of these composites in comparison with standard materials. Applications: Applications of metal, ceramic and polymermatrix composites, Multiscale and nano composites, Hybrid compositesand Sandwich composites, self-reinforced composites and carbon/carbon composites.	9
II	<b>MANUFACTURING OF COMPOSITES</b> Raw Materials: Introduction, Reinforcements manufacturing, Matrix materials manufacturing, Fabric constructions. 3D Braided performs, Pepsregs, Moulding compounds-Materials selections, guidelines. Manufacture of PMC's, VARTEM and SCRIMP, Manufacture of MMC's C/C and CMC's - processing- Forming structural shapes- Different casting methods, Sol-gel method, Non-autoclave curing- Manufacturing defects.	9
III	<b>ASSEMBLY AND COMPOSITE PRODUCTS</b> Smart composites, Joints and assembly of composites, Design for assembly and environment, Materials selection principles in composites, Case studies in design and development of composite parts, boats, pressure vessels, automotive parts, aerospace parts, electronics parts and composites for space vehicles	9
IV	<b>MODERN METALLIC MATERIALS</b> Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Inter metallics, Ni and Ti Aluminides. Non-metallic Materials: Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, structure, Properties and Applications of Engineering Polymers.	9
V	<b>SMART MATERIALS</b> Shape Memory Alloys, Varistors and Intelligent materials for bio-medical applications. Nano materials: Definition, Types of nano materials including carbon nano tubes and nano composites, Physical and mechanical properties, Applications of nano materials.	9
<b>Total Instructional Hours</b>		<b>45</b>

- Course Outcome**
- Upon completion of the course, students will be able to
- CO1: Classify composite materials and their applications
  - CO2: Make use of the knowledge in manufacturing processes of composite materials
  - CO3: Apply the material selection concepts to select a material for a given application.
  - CO4: Design composite subjected to different environmental conditions
  - CO5: Understand the behavior and applications of smart materials, and non metallic materials.

**TEXT BOOKS:**

T1 - M.Balasubramanian. Composite materials processing. 1st edition, CRC press. 2013.

T2 - Williams D Callister. "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2007


**REFERENCE BOOKS:**

R1 - Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint 2002


R2 - Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	2	3	3	-			2	-	3	3	2
CO2	3	2	2	2	3	3	-			2	-	3	3	2
CO3	2	3	2	2	2	3	-			2	-	2	3	3
CO4	2	3	2	2	2	2	-			2	-	2	3	3
CO5	3	2	2	2	2	3	-			2	-	2	3	3
AVG	2.4	2.4	2	2	2.4	2.8	-	-	-	2	-	2.4	3	2.6

  
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**Dean (Academics)**  
**HICET**

# **CURRICULUM**

## **2019 R**



**DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS**

**CBCS PATTERN**

**UNDERGRADUATE PROGRAMMES**

**B.E. AUTOMOBILE ENGINEERING (UG)**

**REGULATION-2019 (Revised on July 2021)**

(For the students admitted during the academic year 2021-2025 and onwards)

**SEMESTER I**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21HE1101	Technical English	HS	2	1	0	3	40	60	100
2	21MA1102	Calculus and Linear Algebra	BS	3	1	0	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
3	21PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	21CY1151	Engineering Chemistry	BS	2	0	2	3	50	50	100
5	21CS1151	Python Programming and practices	ES	2	0	2	3	50	50	100
6	21ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
<b>PRACTICAL</b>										
7	21HE1071	Language Competency Enhancement Course - I	HS	0	0	2	1	0	100	100
<b>NON-CREDIT MANDATORY COURSE</b>										
8	21HE1072	Career Guidance Level - I Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
9	21HE1073	Entrepreneurship and Innovation	EEC	1	0	0	0	100	0	100
<b>Total</b>				<b>15</b>	<b>2</b>	<b>12</b>	<b>20</b>	<b>480</b>	<b>420</b>	<b>900</b>
<b>As Per AICTE Norms 3 Weeks Induction Programme is Added in The First Semester as an Audit Course</b>										

**SEMESTER II**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA <sup>2</sup>	ESE	TOTAL
<b>THEORY</b>										
1	21HE2101	Business English for Engineers	HS	2	1	0	3	40	60	100
2	21MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	40	60	100
3	21ME2101	Engineering Mechanics	ES	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
4	21PH2151	Material Science	BS	2	0	2	3	50	50	100
5	21CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
6	21IT2151	Programming in C	ES	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
7	21ME2001	Engineering Practices	ES	0	0	4	2	60	40	100
8	21HE2071	Language Competency Enhancement Course - II	HS	0	0	2	1	0	100	100
<b>NON-CREDIT MANDATORY COURSE</b>										
9	21HE2072	Career Guidance Level – II Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
<b>Total</b>				<b>17</b>	<b>2</b>	<b>12</b>	<b>22</b>	<b>530</b>	<b>370</b>	<b>900</b>

**SEMESTER III**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21MA3101	Fourier Series and Statistics	BS	3	1	0	4	40	60	100
2	21AU3201	Fluid and Pneumatic Systems	PC	3	1	0	4	40	60	100
3	21AU3202	Engineering Thermodynamics	PC	3	0	0	3	40	60	100
4	21AU3203	Theory of Automotive Engines	PC	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
5	21AU3251	Automotive Structures and Design	PC	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
6	21AU3001	Automotive Components Lab	PC	0	0	3	1.5	60	40	100
7	21AU3002	Computer Aided Drawing Lab	PC	0	0	3	1.5	60	40	100
<b>NON CREDIT MANDATORY COURSE</b>										
8	21MC3191	Indian Constitution	MC	2	0	0	0	100	-	100
9	21HE3072	Career Guidance – Level III Personality, Aptitude and Career Development	EEC	2	0	0	0	100	-	100
10	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	-	100
<b>Total</b>				<b>20</b>	<b>2</b>	<b>8</b>	<b>20</b>	<b>630</b>	<b>370</b>	<b>1000</b>

**SEMESTER IV**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA*	ESE	TOTAL
<b>THEORY</b>										
1	21MA4101	Numerical Methods	BS	3	1	0	4	40	60	100
2	21AU4201	Mechanism and Machine Theory	PC	3	1	0	4	40	60	100
3	21AU4202	Automotive Engine Components Design	PC	3	1	0	4	40	60	100
4	21AU4203	Two and Three Wheelers Technology	PC	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
5	21AU4251	Fundamentals of Heat Transfer	PC	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
6	21AU4001	Computer Aided Automotive Engine Components Lab	PC	0	0	3	1.5	60	40	100
7	21AU4002	Two and Three Wheelers Technology Lab	PC	0	0	3	1.5	60	40	100
<b>NON CREDIT MANDATORY COURSE</b>										
8	21MC4191	Essence of Indian Traditional Knowledge	MC	2	0	0	0	100	-	100
9	21HE4072	Career Guidance – Level IV Personality, Aptitude and Career Development	EEC	2	0	0	0	100	-	100
<b>Total</b>				<b>18</b>	<b>3</b>	<b>8</b>	<b>21</b>	<b>530</b>	<b>370</b>	<b>900</b>

**SEMESTER V**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21AU5201	Automotive Emission and Pollution Control	PC	3	0	0	3	40	60	100
2	21AU5202	Vehicle Design and Data Characteristics	PC	3	1	0	4	40	60	100
3	21AU5203	Automotive Fuels and Lubricants	PC	3	0	0	3	40	60	100
4	21AU53XX	Professional Elective – I	PE	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
5	21AU5251	Automotive Transmission	PC	2	0	2	3	50	50	100
6	21AU5252	Automotive Chassis Components Design**	PC	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
7	21AU5001	Engine Performance and Emission Testing Lab	PC	0	0	3	1.5	60	40	100
8	21AU5002	Automotive Fuels and Lubricants Lab	PC	0	0	3	1.5	60	40	100
<b>ONE CREDIT MANDATORY COURSE</b>										
9	21HE5071	Soft Skill I	EEC	1	0	0	1	100	-	100
10	21HE5072	Design Thinking	EEC	1	0	0	1	100	-	100
<b>Total :</b>				<b>18</b>	<b>1</b>	<b>10</b>	<b>24</b>	<b>580</b>	<b>420</b>	<b>1000</b>

**SEMESTER VI**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA*	ESE	TOTAL
<b>THEORY</b>										
1	21AU6201	Total Quality Management	HS	3	0	0	3	40	60	100
2	21AU6202	Vehicle Dynamics and Control Systems	PC	3	0	0	3	40	60	100
3	21AU6203	Finite Element Analysis	PC	3	1	0	4	40	60	100
4	21AU63XX	Professional Elective – 2	PE	3	0	0	3	40	60	100
5	21XX64XX	Open Elective - 1	OE	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
6	21AU6251	Automotive Vehicle Body and Aerodynamics	PC	2	0	3	3.5	50	50	100
<b>PRACTICAL</b>										
7	21AU6001	Finite Element Analysis Lab	PC	0	0	3	1.5	60	40	100
<b>ONE CREDIT MANDATORY COURSE</b>										
8	21AU6701	Internship Training / In plant Training	EEC	0	0	0	1	100		100
9	21HE6071	Soft Skill-II	EEC	1	0	0	1	100	-	100
10	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	-	100
<b>Total :</b>				<b>19</b>	<b>1</b>	<b>6</b>	<b>24</b>	<b>610</b>	<b>390</b>	<b>1000</b>

**SEMESTER VII**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21AU7201	Advanced Electrical and Electronics	PC	3	0	0	3	40	60	100
2	21AU7202	Engine and Vehicle Management Systems	PC	3	0	0	3	40	60	100
3	21AU73XX	Professional Elective – 3	PE	3	0	0	3	40	60	100
4	21XX74XX	Open Elective – 2	OE	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
5	21AU7251	Electric and Hybrid Vehicle\$\$	PC	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
6	21AU7001	Advanced Electrical and Electronics Lab	PC	0	0	3	1.5	60	40	100
7	21AU7002	Vehicle Maintenance Laboratory	PC	0	0	3	1.5	60	40	100
<b>PROJECT</b>										
8	21AU7901	Project Work – Phase I	EEC	0	0	4	2	50	50	100
<b>Total</b>				<b>14</b>	<b>0</b>	<b>12</b>	<b>20</b>	<b>380</b>	<b>420</b>	<b>800</b>

**SEMESTER VIII**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA*	ESE	TOTAL
<b>THEORY</b>										
1	21AU83XX	Professional Elective – 4	PE	3	0	0	3	40	60	100
2	21AU83XX	Professional Elective – 5	PE	3	0	0	3	40	60	100
<b>PROJECT</b>										
3	21AU8901	Project Work – Phase II	EEC	0	0	16	08	100	100	200
<b>Total :</b>				<b>6</b>	<b>0</b>	<b>16</b>	<b>14</b>	<b>180</b>	<b>220</b>	<b>400</b>

Credit Distribution - Semester Wise

Sem	I	II	III	IV	V	VI	VII	VII	Total
Credits	20	22	20	21	24	24	20	14	165

**Total Number of Credits to be Earned for Award of the Degree = 165**

**LIST OF PROFESSIONAL ELECTIVES**

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
<b>PROFESSIONAL ELECTIVE I</b>									
1	21AU5301	Alternative Fuels and Energy Systems	3	0	0	3	40	60	100
2	21AU5302	Tyre Technology	3	0	0	3	40	60	100
3	21AU5303	Automotive Materials and Manufacturing Technology	3	0	0	3	40	60	100
4	21AU5304	Battery Technology	3	0	0	3	40	60	100
5	21AU5305	Plastic Parts Manufacturing Technology	3	0	0	3	40	60	100
6	21AU5306	Composite Materials	3	0	0	3	40	60	100
<b>PROFESSIONAL ELECTIVE II</b>									
1	21AU6301	Automotive Airconditioning	3	0	0	3	40	60	100
2	21AU6302	Fuel Cell Technology	3	0	0	3	40	60	100
3	21AU6303	Ergonomics in Automotive Design	3	0	0	3	40	60	100
4	21AU6304	Additive Manufacturing	3	0	0	3	40	60	100
5	21AU6305	Robotics	3	0	0	3	40	60	100
<b>PROFESSIONAL ELECTIVE III</b>									
1	21AU7301	Automotive Vehicle Maintenance	3	0	0	3	40	60	100
2	21AU7302	Digital Supply Chain Management	3	0	0	3	40	60	100
3	21AU7303	Engine Auxiliary Systems	3	0	0	3	40	60	100
4	21AU7304	Tribology and Terotechnology	3	0	0	3	40	60	100
5	21AU7305	Entrepreneurship Development	3	0	0	3	40	60	100
6	21AU7306	Automotive Embedded Systems	3	0	0	3	40	60	100
<b>PROFESSIONAL ELECTIVE IV</b>									
1	21AU8301	Digital Vehicle Monitoring	3	0	0	3	40	60	100
2	21AU8302	Computational Fluid Dynamics	3	0	0	3	40	60	100
3	21AU8303	Automotive Painting Technology	3	0	0	3	40	60	100
4	21AU8304	Non-Destructive Testing and Materials	3	0	0	3	40	60	100
5	21AU8305	Motorsports Engineering	3	0	0	3	40	60	100



PROFESSIONAL ELECTIVE V									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU8306	Automotive Cyber Security	3	0	0	3	40	60	100
2	21AU8307	Industry 4.0	3	0	0	3	40	60	100
3	21AU8308	Autonomous Vehicle Technology	3	0	0	3	40	60	100
4	21AU8309	Off Road Vehicles	3	0	0	3	40	60	100
5	21AU8310	Unconventional Machining Processes	3	0	0	3	40	60	100
6	21AU8311	Vehicle Transport Management	3	0	0	3	40	60	100
OPEN ELECTIVE (OE)									
1	21AU6401	Basics of Automobile Engineering	3	0	0	3	40	60	100
2	21AU7402	Automotive Safety	3	0	0	3	40	60	100
LIFE SKILL OPEN ELECTIVES COURSES									
1	21LSX401	General Studies for Competitive Examinations	3	0	0	3	40	60	100
2	21LSX402	Human Rights, Women's Rights and Gender Equality	3	0	0	3	40	60	100
3	21LSX403	Indian Ethos and Human Values	3	0	0	3	40	60	100
4	21LSX404	Indian Constitution and Political System	3	0	0	3	40	60	100
5	21LSX405	Yoga for Human Excellence	3	0	0	3	40	60	100
NCC OPEN ELECTIVE COURSES (Only for the students' who have opted NCC subjects in Semester I, II, III & IV are eligible)									
1	21HEZ401	NCC course level 1	3	0	0	3	40	60	100
2	21HEZ402	NCC course level 2	3	0	0	3	40	60	100

Minor Degree - Automotive Vehicle Technology (Offered by Automobile Engineering )									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU5601	Automotive Engines	3	0	0	3	40	60	100
2	21AU6601	Automotive Chassis	3	0	0	3	40	60	100
3	21AU6602	Automotive Transmission	3	0	0	3	40	60	100
4	21AU7601	Automotive Electronics	3	0	0	3	40	60	100
5	21AU7602	Intelligent vehicular systems	3	0	0	3	40	60	100
6	21AU8601	Electric and Hybrid vehicles	3	0	0	3	40	60	100

Minor Degree - Fintech and Block Chain (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21CS5601	Financial Management	3	0	0	3	40	60	100
2	21CS5602	Fundamentals of Investment	3	0	0	3	40	60	100
3	21CS5603	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	21CS5604	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	21CS5605	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	21CS5606	Introduction to Fintech	3	0	0	3	40	60	100

Minor Degree - Entrepreneurship (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21BA5601	Foundation of Entrepreneurship	3	0	0	3	40	60	100
2	21BA6601	Introduction to Business Venture	3	0	0	3	40	60	100
3	21BA6602	Team Building & Leadership Management for Business	3	0	0	3	40	60	100
4	21BA7601	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100
5	21BA7602	Principles of Marketing Management for Business	3	0	0	3	40	60	100
6	21BA8601	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100

Minor Degree - Environment and Sustainability (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21CEXXXX	Sustainable infrastructure Development	3	0	0	3	40	60	100
2	21CEXXXX	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
3	21CEXXXX	Sustainable Bio Materials	3	0	0	3	40	60	100
4	21CEXXXX	Materials for Energy Sustainability	3	0	0	3	40	60	100
5	21CEXXXX	Green Technology	3	0	0	3	40	60	100
6	21CEXXXX	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100

Honors Degree - Electric and hybrid vehicle development									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU5204	Fundamentals of Electric and Hybrid Vehicles	3	0	0	3	40	60	100
2	21AU6204	Battery Technology	3	0	0	3	40	60	100
3	21AU6205	Automotive Embedded Systems	3	0	0	3	40	60	100
4	21AU7203	Advanced Automotive Safety Systems	3	0	0	3	40	60	100

5	21AU7204	Electric Vehicle Technology	3	0	0	3	40	60	100
6	21AU8201	Electric Vehicles and its Sustainable Development	3	0	0	3	40	60	100
<b>Honors Degree - Motorsport Engineering</b>									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU5205	Composite Structure	3	0	0	3	40	60	100
2	21AU6206	High performance engine design	3	0	0	3	40	60	100
3	21AU6207	Motorsports Electric Vehicle	3	0	0	3	40	60	100
4	21AU7205	Motorsports Vehicle Body Engineering	3	0	0	3	40	60	100
5	21AU7206	Motorsports Race Electronics and Control Systems	3	0	0	3	40	60	100
6	21AU8202	Motorsports racing circuits and Design	3	0	0	3	40	60	100
<b>Honors Degree - Vehicle Development and Validation</b>									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU5206	Automotive Product Design and Development	3	0	0	3	40	60	100
2	21AU6208	Noise, Vibration and Harshness	3	0	0	3	40	60	100
3	21AU6209	Automotive Instrumentation	3	0	0	3	40	60	100
4	21AU7207	Testing and Measurement Systems	3	0	0	3	40	60	100
5	21AU7208	Homologation	3	0	0	3	40	60	100
6	21AU8203	Automotive Prototyping	3	0	0	3	40	60	100

### CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	26	24	18	14	165


\* Student can earn extra credit 35 over and above the total credits

<b>ADDITIONAL CREDIT COURSE FOR NCC CADETS</b>										
S.No	Course code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1	21HE1074	NCC General and National Integration	VA	1	0	0	1	100	0	100
2	21HE2074	Social Services and Community Development	VA	1	0	0	1	100	0	100
3	21HE3074	Leadership Qualities and Camp Activities	VA	1	0	0	1	100	0	100
4	21HE4074	General awareness, communication and Aero engines	VA	1	0	0	1	100	0	100


<b>ADDITIONAL CREDIT COURSE FOR AUTOMOBILE ENGINEERING</b>						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit

1	21VAAU01	Foundry Technology	VA	30 hrs	Internal	1
2	21VAAU02	Forming and Shaping of Plastics	VA	30 hrs	Internal	1
3	21VAAU03	Microcontroller Programming in Automotive applications	VA	30 hrs	Internal	1
4	21VAAU04	Vehicle development and testing regulations (ARAI)	VA	30 hrs	Internal	1
5	21VAAU05	Bigdata Analysis	VA	30 hrs	Internal	1
6	21VAAU06	Data mining	VA	30 hrs	Internal	1
7	21VAAU07	Fire and safety Engineering	VA	30 hrs	Internal	1
8	21VAAU08	Introduction to MS office	VA	30 hrs	Internal	1
9.	21VAAU09	Autodesk Fusion 360	VA	30 hrs	Internal	1

**Note: Non Credit Course results will not consider for Award of Degree**

  
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**Chairman - BoS**  
**AUTO - HICET**

  
 Dean - Academics  
**Dean (Academics)**  
**HICET**

  
 Principal  
**PRINCIPAL**  
 Hindusthan College Of Engineering & Technology  
 COIMBATORE - 641 032.

**Course Objectives**

1. To understand the fundamentals, operating principles of batteries and starting systems.
2. To illustrate the functionality of charging and lighting systems.
3. To comprehend the concepts of electronic engine controls.
4. To know about safety electronics and working principle of sensors.
5. To acquire knowledge about future automotive electronics.

**UNIT I BATTERY AND STARTING SYSTEM (9)**

Battery – principle – Lead acid battery – characteristics - rating - efficiency of batteries – tests conducted on battery – charging methods – maintenance - free batteries - starter motor - principle - construction - drive mechanisms – maintenance – starter switches.

**UNIT II CHARGING AND LIGHTING SYSTEM (9)**

DC generators and alternators in vehicles - cut out relay- regulators – three unit regulator - Positive & negative earth systems - vehicle interior and exterior lighting system – headlight & fog light design - Adaptive Lighting system - LED lighting system.

**UNIT III ELECTRONIC ENGINE CONTROLS (9)**

Electronic ignition control - battery coil, magneto and electronic ignition systems – Programmed ignition - Spark plugs - electronic fuel injection - throttle body fuel injection - multi point fuel injection - gasoline direct injection - common rail direct injection - L- Jetronic fuel injection- engine mapping-on-board diagnostics.

**UNIT IV SAFETY ELECTRONICS AND SENSORS IN AUTOMOBILES (8)**

Safety electronic systems – Anti lock braking system - Traction Control System - Electronic stability program - Cruise Control System - Microcontrollers - Sensor Sensors in automobile - sensor for speed, throttle position, exhaust oxygen level, manifold pressure, air mass flow.

**UNIT V FUTURE AUTOMOTIVE ELECTRONIC SYSTEMS (9)**

Electric and Hybrid vehicles - Collision Avoidance - Radar warning Systems - Heads Up display - Navigation – Navigation Sensors - Radio Navigation - Signpost navigation - dead reckoning navigation - Voice Recognition Cell Phone dialing - Automatic driving Control - Key less entry system

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the functions of batteries and charging system.  
 CO2: Know about the charging and lighting system.  
 CO3: Organize the fundamentals of electronic engine controls.  
 CO4: Make use of the safety electronics.  
 CO5: Analyze the future automotive electronics systems.

**Text Books**

- T1 Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 9783658017835  
 T2 Tom Denton., “Automobile Electrical and Electronics Systems”, Elsevier Butterworth-Heinemann Linacre House, 2004.  
 T3 Judge, A.W., “Modern Electrical Equipment of Automobiles”, Chapman & Hall, London, 1992.

**References**


- R1 Barry Holebeak, “Automotive Electrical and Electronics”, Delmar Publishers, Clifton Park, USA, 2010  
 R2 Tom Denton, “Automotive Electrical and Electronics Systems,” Third Edition, 2004, SAE International  
 R3 William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	1	2	-	-	3	-	-	2	-	3	2	2
CO2	3	3	3	2	-	-	3	-	-	2	-	3	2	2
CO3	3	3	3	1	2	-	2	-	-	2	-	3	2	3
CO4	3	2	2	2	2	2	2	-	-	2	-	2	2	2
CO5	3	2	3	2	2	3	2	-	-	2	-	2	2	2
AVG	3	2.6	2.4	1.8	2	2.5	2.4	-	-	2	-	2.6	2	2.2

  
 Chairman, Board of Studies  
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**AUTO - HICET**



  
 Dean - Academics

**Course Objectives**

1. To get exposure in microprocessor architecture and fuzzy logic.
2. To understand the fundamental of sensors and actuators.
3. To impart the knowledge of electronics in SI engine management system.
4. To Acquire knowledge of CI engine management systems.
5. To build strong base in vehicle management system.

**UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS (9)**

Microprocessor architecture-open and closed loop control strategies-PID control-Look up tables-A/D and D/A converters. Introduction to modern control strategies like Fuzzy logic- Parameters to be controlled in SI and CI engines and in the other parts of the automobile.

**UNIT II SENSOR TECHNOLOGIES (9)**

Inductive, crank shaft position, steering torque, cam position, steering position, hot wire, engine and wheel speed, thermistor, piezo electric, knock piezo resistive based sensors-throttle position, fuel level, air mass flow, engine temperature, manifold temperature and pressure sensors. Tire pressure, brake pressure, crash, exhaust oxygen level (two step and linear lambda), Solenoid, relay, stepper motor.

**UNIT III SI ENGINE MANAGEMENT (9)**

Smart hybrid technology. Group and sequential injection- Fuel control maps-open loop control fuel injection and closed loop lambda control. Closed loop control of knock, VVT, gasoline turbodirect injection system. Distributor less ignition, Introduction to LASER Ignition system.

**UNIT IV CI ENGINE MANAGEMENT (9)**

Fuel injection system-parameters affecting combustion-noise and emissions in CI engines-Pilot- main-advanced post injection-retarded post injection-common rail fuel injection system (CRDi) -Fuel injector-fuel pump-rail pressure limiter-flow limiter-EGR valves Three-way catalytic converter-conversion efficiency versus lambda, ammonia injection.

**UNIT V VEHICLE MANAGEMENT SYSTEMS (9)**

ABS, EBD, TCS, ESP system-need-working. Electronic control of suspension-Damping Control-Electric power steering-hill hold control, Supplementary Restraint System- seat belt tightening-cruise control-Vehicle security systems-alarms vehicle tracking system-On board diagnostics-Collision avoidance Radar warning system - Automotive Infotainment Systems.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Describe the microprocessor application in automobiles.  
 CO2: Explain their competent in-depth knowledge in autotronics.  
 CO3: Explain about gasoline engine management system.  
 CO4: Find faults and troubleshoot in SI engine management systems.  
 CO5: Illustrate the knowledge in vehicle control system.

**Text Books**

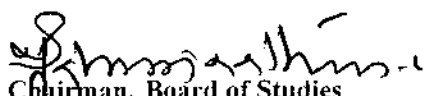
- T1 Bosch, "Automotive Sensors", Robert Bosch GmbH, 2001.  
 T2 William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.  
 T3 Diesel Maintenance, Tune-up and Engine Management, Volume 1-EP.D050 Rennicks October 16, 2004.

**References**

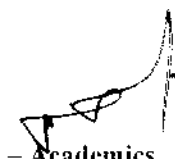
- R1 Gasoline Engine Management: Motronic Systems: Bosch Technical Instruction Robert Bosch GmbH November 1, 2003.  
 R2 Engine Management: Advanced Tuning 1st Edition CarTech; 1st edition April 10, 2007.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	2	3	3	-	-	-	2	-	3	3	2
CO2	3	2	2	2	3	3	2	-	-	2	-	3	3	2
CO3	2	3	2	2	2	3	-	-	-	2	-	2	3	3
CO4	2	3	2	2	2	2	-	-	-	2	-	2	3	3
CO5	3	2	2	2	2	3	-	-	-	2	-	2	3	3
AVG	2.4	2.4	2	2	2.4	2.8	2	-	-	2	-	2.4	3	2.6

  
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 Dean - Academics  
**Dean (Academics)**  
**HiCET**

**Course Objectives**

1. To comprehend general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub system design and hybrid vehicle control.
2. To Understand about vehicle dynamics
3. To Design the required energy storage devices
4. To Select the suitable electric propulsion systems
5. To Understand of hybrid electric vehicles

**UNIT I NEED FOR ALTERNATIVE SYSTEM (9)**

Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

- Components and Working Principles of Hybrid and Electric Vehicles

**UNIT II DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES (9)**

Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems.

- Range and Power Requirement Calculation

**UNIT III ENERGY SOURCES (9)**

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

- Battery Testing and Modeling

**UNIT IV MOTORS AND CONTROLLERS (9)**

Types of Motors, Characteristic of DC motors, AC single phase and 3-phase motor, PM motors, switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/DC converters.

- Performance characteristics of various motors used in electric vehicles.

**UNIT V ENERGY MANAGEMENT SYSTEMS (9)**

Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

- Implement and test a Controller Area Network (CAN) for in-vehicle communication.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Summarize the electric and hybrid vehicle operation and architectures  
 CO2: Design and develop the systems of hybrid and electric vehicles  
 CO3: Demonstrate the energy requirement for vehicles  
 CO4: Model and simulate the vehicle characteristics, operating modes, and performance parameters of the vehicle  
 CO5: Explain the different subsystems of hybrid and electric vehicles

**Text Books**

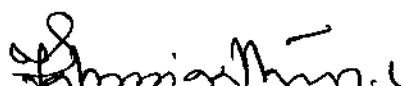
- T1 Iqbal Husain, "Electric and Hybrid Vehicles-Design Fundamentals", CRC Press, 2003  
 T2 Mehrdad Ehsani, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press,2005.

**References**


- R1 Sandeep Dhameja, "Electric Vehicle Battery Systems" NEWNES, 2002  
 R2 James Larminie and John Lowry, "Electric Vehicle Technology Explained" John Wiley & Sons, 2003  
 R3 Ron Hodkinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication,2005

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	2	3	3	-			2	-	3	3	2
CO2	3	2	2	2	3	3	2			2	-	3	3	2
CO3	2	3	2	2	2	3	-			2	-	2	3	3
CO4	2	3	2	2	2	2	-			2	-	2	3	3
CO5	3	2	2	2	2	3	-			2	-	2	3	3
AVG	2.4	2.4	2	2	2.4	2.8	2	-	-	2	-	2.4	3	2.6

  
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**Dean (Academics)**  
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**Course Objectives**

1. To do testing and maintenance of batteries, starting motors and generators
2. To perform testing of regulators and cut-outs relays.
3. To diagnose of ignition system faults.
4. To study the automobile electrical wiring system.
5. To gain a wide knowledge in the basic electronic components and circuits.

**LIST OF EXPERIMENTS****a. Electrical Laboratory**

1. Testing of batteries and battery maintenance
2. Testing of starting motors and generators
3. Testing of regulators and cut – outs
4. Diagnosis of ignition system faults
5. Study of Automobile electrical wiring

**b. Electronics Laboratory**

1. Study of rectifiers, Logic gates, SCR timer
2. Interfacing of analog sensors like RTD, LVDT, and Load Cell with micro-controller
3. Interfacing of actuators like stepper motor with micro-controller
4. Study of Analog to Digital and Digital to Analog converters
5. Micro Processor programming and interfacing
6. Study and on board diagnosis of Engine Management System
7. Study of Virtual Instrumentation
8. First order and Second Order System using MatLab
9. Routh Table Analysis using MatLab

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Comprehend the working and troubleshooting of battery, regulators and cut-out relays.
- CO2: Demonstrate and diagnose the ignition system.
- CO3: Interface the sensors and actuators with microcontroller.
- CO4: Observe and troubleshoot the automotive electrical circuits and systems.
- CO5: Get exposure in the state of the art electronic technologies in testing and controlling of vehicles.

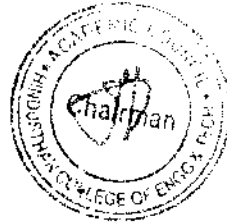
**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

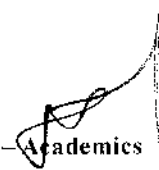
S.No.	NAME OF THE EQUIPMENT	QTY.	S.No.	NAME OF THE EQUIPMENT	QTY.
1	Battery, hydrometer, voltage tester	1 Each	8	IC timer	15
2	Starter motor, regulator, cut-out	1 Each	9	Data logger	1
3	Distributor, ignition coil, spark plug	1 Each	10	8085 trainer kit	10
4	Auto electrical wiring system	1	11	ADC interface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

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	2	1	3	3	2	-	3	1	3	3	3
CO2	3	3	2	3	1	3	3	2	-	2	1	3	2	2
CO3	3	3	2	2	3	2	2	2	-	2	1	3	2	2
CO4	3	3	1	3	3	3	3	2	-	2	1	3	3	3
CO5	3	3	2	3	3	3	3	2	-	2	1	3	3	3
AVG	3	3	1.8	2.6	2.2	2.8	2.8	2	-	2.2	1	3	2.6	2.6

  
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**AUTO - HICET**



  
 Dean - Academics  
**Dean (Academics)**  
**HICET**

**Course Objectives**

1. To understand the complete knowledge of the vehicle maintenance procedures
2. To acquire skills in handling situations where the vehicle is likely to fail
3. To understand various types of maintenance of vehicles, features and applications
4. To apply the knowledge in servicing vehicle components
5. To analyze the fault in modern engine using engine analyzer

**LIST OF EXPERIMENTS****STUDY EXPERIMENTS:**

1. Tools and instruments required for maintenance
2. Safety aspects with respect to man, machine and tools
3. General procedures for servicing and maintenance schedule
4. Wheel Alignment procedure

**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 and service of transmission system
5. Fault diagnosis and service of driveline system
6. Fault diagnosis and service of braking system
7. Fault diagnosis and service of suspension system
8. Fault diagnosis and service of steering system
9. Fault diagnosis and service of electrical system like battery, starting system, charging system, lighting system etc.
10. Fault diagnosis and service of vehicle air conditioning system
11. Practice the following:
  - a. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel play.
  - b. Air bleeding from hydraulic brakes, air bleeding of diesel fuel system.
  - c. Wheel bearings tightening and adjustment.
  - d. Adjustment of head lights beam.
  - e. Removal and fitting of tire and tube.
  - f. Study and checking of wheel alignment - testing of camber, caster.
  - g. Testing kingpin inclination, toe-in and toe-out
  - h. Cylinder reboring – checking the cylinder bore, Setting the tool and reboring.
  - i. Valve grinding, valve lapping-Setting the valve angle, grinding and lapping and checking for valve leakage
  - j. Tinkering and painting of passenger car door

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Describe the minor and major tuning of diesel and petrol engines
- CO2: Dismantle, study, perform corrections and assemble the vehicle systems
- CO3: Perform the wheel alignment procedure and tyre removal procedure, etc.
- CO4: Define the procedures of valve grinding, lapping, reboring calibration of fuel injection pump, etc.
- CO5: Find faults, and rectify them to perform maintenance of automotive systems

### LIST OF EQUIPMENT

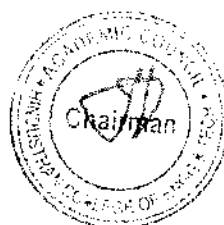
S.No.	NAME OF THE EQUIPMENT	QTY
1	Engine Analyze	1
2	Cylinder Compression Pressure Gauge	1
3	Vacuum Gauge	1
4	Spark Plug Cleaner and Tester	1
5	Cam Angle and RPM Tester	1
6	Tachometer	1
7	Wheel Alignment Apparatus	1
8	Gas Welding Equipment	1
9	Tyre Remover	1
10	Bearing Puller	1
11	Head Light Alignment Gauge	1
12	Service manuals of Petrol, Diesel Engines	1 Each
13	Cylinder Reboring Machine	1
14	Valve Grinding Machine	1
15	Valve Lapping Machine	1
16	Fuel injection calibration test bench with nozzle tester	1
17	HRD tester, Clamp on meter, Hydrometer	1 Each
18	Tinkering kit	2
19	Surface polisher	2
20	Paint spray gun	2
21	Air compressor	1

### CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	2	-	3	2	2	-	-	-	3	2	2
CO2	3	3	2	3	-	3	3	2	-	-	-	2	3	2
CO3	3	3	1	2	-	3	2	2	-	-	-	2	2	3
CO4	3	3	2	2	-	3	2	-	-	-	-	2	2	2
CO5	3	3	2	2	-	2	2	-	-	-	-	2	3	2
AVG	3	3	1.8	2.2	-	2.8	2.2	2	-	-	-	2.2	2.4	2.2

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**Course Objectives**

1. To practice acquired knowledge within the chosen area of technology for project development.
2. To Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
3. To Reproduce, improve and refine technical aspects for engineering projects.
4. To Work as an individual or in a team in development of technical projects.
5. To Communicate and report effectively project related activities and findings

The student 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 COE / Head of the Department.

**Course Outcomes**

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

CO1: Able to practice acquired knowledge within the chosen area of technology for project development.

CO2: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

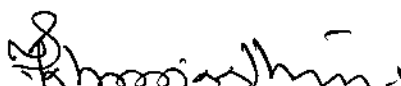
CO3: Reproduce, improve and refine technical aspects for engineering projects.

CO4: Work as an individual or in a team in development of technical projects.

CO5: Communicate and report effectively project related activities and findings

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	2	2	2	3	3	3	3	3	3	3
CO2	3	1	2	1	2	2	2	3	2	2	3	3	2	2
CO3	2	3	3	2	2	2	2	2	3	3	2	2	3	3
CO4	3	3	3	3	2	2	2	3	3	3	3	3	3	3
CO5	3	1	2	1	2	2	2	3	2	2	3	3	2	2
AVG	2.8	2.2	2.6	2	2	2	2	2.8	2.6	2.6	2.8	2.8	2.6	2.6

  
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**Course Objectives**

- 1 To understand the concepts of maintenance records and schedules.
- 2 To comprehend the necessary details to understand the engine repair and over hauling.
- 3 To provide the necessary knowledge on chassis repair and over hauling.
- 4 To have the knowledge on vehicle body maintenance and repair.
- 5 To understand the electrical system servicing and repair procedure.

**UNIT I MAINTENANCE TOOL, SHOP, SCHEDULE, RECORDS (8)**

Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

**UNIT II POWER PLANT REPAIR AND OVERHAULING (9)**

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

**UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS (10)**

Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems.

**UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY (9)**

Body panel tools for repairing. Tinkering and painting. Use of soldering, metalloid paste. Tyre maintenance, metallic, plastics

**UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS (9)**

Care, maintenance, testing and troubleshooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Apply the knowledge on maintenance tools and records.
- CO2: Analyze the various procedures avail to carry out engine repair and over hauling.
- CO3: Dismantle, Study and assemble the various parts of chassis sub systems.
- CO4: Attain the knowledge of maintenance and repair of vehicle body.
- CO5: Describe the maintenance procedure of various electrical subsystems.

**Text Books**

- T1 Ernest Venk and Edward spicer, "Automotive maintenance and troubleshooting", D.B. Taraporevala Sons, 2008.
- T2 Ed May, "Automotive Mechanics Volume One", Mc Graw Hill Publications, 2006

**References**

- R1 Bosch Automotive Handbook, Tenth Edition, 2018
- R2 Doshi.J.A. "Vehicle Maintenance and Garage Practice", Prentice Hall India Learning Private Limited, 2014.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
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CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

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**Course Objectives**

- 1 To know about the supply chain management concepts and its implications
- 2 To acquire the knowledge about strategic sourcing.
- 3 To infer about the various steps and sequences of supply chain network.
- 4 To understand the procedures involved in planning, demand, inventory and supply.
- 5 To get exposure in current trends and techniques in digital SCM.

**UNIT I INTRODUCTION**

(9)

Supply Chain – Fundamentals – Evolution - Role in Economy - Importance - Decision Phases - Supplier- Manufacturer- Customer chain. - Enablers/ Drivers of Supply Chain Performance. Supply chain strategy - Supply Chain Performance Measures.

**UNIT II STRATEGIC SOURCING**

(9)

Outsourcing – Make Vs buy - Identifying core processes - Market Vs Hierarchy - Make Vs buy continuum - Sourcing strategy - Supplier Selection and Contract Negotiation. Creating a world class supply base - Supplier Development - World Wide Sourcing.

**UNIT III SUPPLY CHAIN NETWORK**

(9)

Distribution Network Design – Role - Factors Influencing Options. Value Addition – Distribution Strategies - Models for Facility Location and Capacity allocation. Distribution Center Location Models. Supply Chain Network optimization models. Impact of uncertainty on Network Design - Network Design decisions using Decision trees.

**UNIT IV PLANNING DEMAND, INVENTORY AND SUPPLY**

(9)

Managing supply chain cycle inventory. Uncertainty in the supply chain -- Analyzing impact of supply chain redesign on the inventory - Risk Pooling - Managing inventory for short life - cycle products - multiple item - multiple location inventory management. Pricing and Revenue Management

**UNIT V CURRENT TRENDS**

(9)

Supply Chain Integration - Building partnership and trust in SC Value of Information: Bullwhip Effect - Effective forecasting - Coordinating the supply chain. . SC Restructuring - SC Mapping - SC process restructuring, Postpone the point of differentiation – IT in Supply Chain - Agile Supply Chains - Reverse Supply chain. Agro Supply Chains.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Know about the supply chain management concepts and its implications
- CO2: Acquire the knowledge about strategic sourcing.
- CO3: Infer about the various steps and sequences of supply chain network.
- CO4: Understand the procedures involved in planning, demand, inventory and supply.
- CO5: Get exposure in current trends and techniques in digital SCM.

**Text Books**

- T1 Janat Shah, Supply Chain Management – Text and Cases, Pearson Education, 2009.
- T2 Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy Planning and Operation, PHI Learning / Pearson Education, Sixth edition, 2015.
- T3 Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, 5th Edition, 2007.

**References**

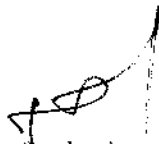
- R1 Amit Gupta & B.L. Gupta, "Railway Engineering", Standard Publish Distributors (2005)
- R2 David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Designing and Managing the Supply Chain: Concepts, Strategies, and Cases, Tata McGraw-Hill, 2005.
- R3 Altekar Rahul V, Supply Chain Management-Concept and Cases, PHI, 2005.
- R4 Joel D. Wisner, G. Keong Leong, Keah-Choon Tan, Principles of Supply Chain Management- A Balanced Approach, South-Western, Cengage, 2012.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
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CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

- 1 To understand the Carburetion systems used in automobiles and their functions.
- 2 To understand the gasoline injection systems used in automobiles and their functions.
- 3 To understand the diesel injection systems used in automobiles and their functions.
- 4 To understand the manifolds and mixture distribution in automobiles and their functions.
- 5 To acquire knowledge in lubrication and cooling systems used in automobiles and their functions.

**UNIT I CARBURETION**

(9)

Introduction- principle of working-factors affecting carburetion-Air fuel mixtures-mixture requirements at different loads and speeds- Carburetor-Essential Parts-different circuits-compensating devices-working -types- Chokes-Effects of altitude on carburetion.

**UNIT II ELECTRONICS INJECTION SYSTEMS**

(9)

Introduction-Need of Gasoline injection-types-components-EFI-merits-Demerits-MPFI system- port injection-throttle body injection-Function of MPFI-Electronic control system - group gasoline injection system- electronic diesel injection system - EDI control-CRFI system.

**UNIT III DIESEL FUEL INJECTION**

(9)

Factors influencing fuel spray atomization- penetration and dispersion of diesel and heavy oils and their properties- rate and duration of injection- fuel line hydraulics- fuel pump- injectors- CRDI systems and its merits and demerits.

**UNIT IV INTAKE AND EXHAUST MANIFOLDS**

(9)

Intake system components- Discharge coefficient- Pressure drop-Air filter-Intake manifold-Connecting pipe-Exhaust system components-Exhaust manifold and exhaust pipe- Spark arresters- Waste heat recovery-Exhaust mufflers-Type of mufflers- exhaust manifold expansion.

**UNIT V LUBRICATION AND COOLING SYSTEMS**

(9)

Lubricants-lubricating systems- Lubrication of piston rings- bearings-oil consumption-Oil cooling. Heat transfer coefficients-liquid and air-cooled engines-coolants-additives and lubricity improvers- concept of adiabatic engines.

**TOTAL:45 PERIODS****Course Outcomes**

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

- CO1: At the end of the course, the student will be familiar with the functionality, construction, working principle of carburetion.
- CO2: Illustrate the electronics injection systems in automotive engines.
- CO3: Illustrate the diesel fuel injection systems in automotive engines.
- CO4: Students can Improve the Manifolds and Mixture Distribution in IC engine.
- CO5: Summarize the lubrication and cooling system in automotive engines.

**Text Books**

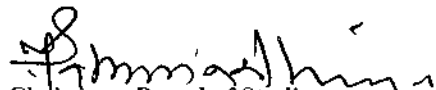
- T1 Ramalingam. K.K., "Internal Combustion Engine", scitech publications,2003
- T2 Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.

**References**

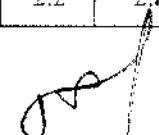
- R1 Konrad Reif, "Fundamentals of Automotive and Engine Technology (Bosch Professional Automotive Information", Springer Nature,2014.
- R2 M. L. Mathur, R. P. Sharma, "Internal combustion engines", Dhanpat Rai Publication, 2005.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
CO2	1	2	-	2	2	3	3	-	-	3	-	2	2	3
CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To understand the concept of tribology with its mechanisms and measurement techniques.
2. To understand friction between surfaces and its behavior in different materials.
3. To learn concept of wear, types and its influence in various materials.
4. To understand the concepts lubrication along with its characteristics.
5. To understand the basic concepts of Terotechnology and scheduled maintenance.

**UNIT I INTRODUCTION TO TRIBOLOGY****(9)**

Introduction to contact between solid surfaces - Analysis of the Contacts - Single Asperity Contact of Homogeneous and Frictionless Solids - Single Asperity Contact of Layered Solids in Frictionless and Frictional Contacts - Multiple Asperity Dry Contacts - Measurement of the Real Area of Contact - Measurement Techniques - Typical Measurements.

**UNIT II FRICTION****(9)**

Introduction to Friction - Solid-Solid Contact - Rules of Sliding Friction - Basic Mechanisms of Sliding Friction - Other Mechanisms of Sliding Friction - Friction Transitions During Sliding - Static Friction - Stick-Slip - Rolling Friction - Liquid-Mediated Contact - Friction of Materials - Friction of Metals and Alloys - Friction of Ceramics - Friction of Polymers - Friction of Solid Lubricants

**UNIT III WEAR****(9)**

Introduction to wear - types of Wear Mechanism - Adhesive Wear - Abrasive Wear (by Plastic Deformation and Fracture) - Fatigue Wear - Impact Wear - Chemical (Corrosive) Wear - Electrical-Arc-Induced Wear - Fretting and Fretting Corrosion - Types of Particles Present in Wear Debris - Plate-Shaped Particles - Ribbon-Shaped Particles - Spherical Particles - Irregularly Shaped Particles - Wear of Materials - Wear of Metals and Alloys - Wear of Ceramics - Wear of Polymers.

**UNIT IV LUBRICATION****(9)**

Introduction to Fluid Film Lubrication - Regimes of Fluid Film Lubrication - Hydrostatic Lubrication - Hydrodynamic Lubrication - Electrohydrodynamic Lubrication - Mixed Lubrication - Boundary Lubrication - Viscous Flow and Reynolds Equation - Viscosity and Newtonian Fluids - Fluid Flow - Hydrostatic Lubrication - Hydrodynamic Lubrication - Thrust Bearings - Journal Bearings - Squeeze Film Bearings - Gas-Lubricated Bearings - Electrohydrodynamic Lubrication - Forms of Contacts - Line Contact - Point Contact - Thermal Correction - Lubricant Rheology

**UNIT V TEROTECHNOLOGY****(9)**

Terotechnology and its influence on plant engineering and maintenance, specific application areas, Overall effectiveness of equipment (OEE) and its measurement RAM analysis: Reliability, Availability, Inherent & Operational and Maintainability. Maintenance Management Practice - Various types of maintenance, breakdown, preventive, periodic or predictive, condition-based maintenance as predictive preventive maintenance.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the basics of Tribology and importance in engineering field.
- CO2: Infer about the friction and its associated effects on surfaces.
- CO3: Understand the wear, its mechanisms and debris analysis.
- CO4: Explain the lubrication principles and methods in real time.
- CO5: Comprehend the concepts of terotechnology and the importance of scheduled maintenance in industries.

**Text Books**

- T1 Bharat Bhusan, "Introduction to Tribology". John Wiley & Sons Publication, 2nd Edition, 2013
- T2 Gwidon W. Stachowiak, Andrew W. Batchelor "Engineering Tribology". Butterworth Heinemann – Elsevier Publications, 3rd Edition, 2005.

**References**

- R1 Dr. Bo N. J. Persson, "Sliding Friction Physical Principles and Applications". Springer Publications, 2<sup>nd</sup> Edition, Springer Publications, 2000.
- R2 B Bhadury and S.K. Basu. "Terotechnology: Reliability Engineering and Maintenance Management". Asian Books, New Delhi 2002.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
CO2	1	2	-	2	2	3	3	-	-	3	-	2	2	3
CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

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**Course Objectives**

- 1 Explaining the types, characteristics of entrepreneurship and its role in economic development.
- 2 Applying the theories of achievement motivation and the principles of entrepreneurship development program to enterprise.
- 3 Selecting the appropriate form of business ownership in setting up an enterprise.
- 4 Applying the fundamental concepts of finance and accounting to enterprise.
- 5 To understand the government policy and start up procedure for small scale industries.

**UNIT I ENTREPRENEURSHIP**

(9)

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth- Factors Affecting Entrepreneurial Growth.

**UNIT II MOTIVATION**

(9)

Major Motives Influencing an entrepreneur – Achievement Motivation Training-Self Rating- Business Games-Thematic Apperception Test – Stress Management-Entrepreneurship Development Programs – Need- Course Objectives.

**UNIT III BUSINESS**

(9)

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity- Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

**UNIT IV FINANCING AND ACCOUNTING**

(9)

Need – Sources of Finance- Term Loans- Capital Structure-Financial Institution-Management of working Capital-Costing-Break Even Analysis-Taxation – Income Tax-Excise Duty – Sales Tax – Return on Investment, Cost estimation and cost of ownership.

**UNIT V SUPPORT TO ENTREPRENEURS**

(9)

Sickness in small Business – Concept-Magnitude-Causes and Consequences- Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion-Diversification- Joint Venture-Merger and Sub Contracting.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Explain the types, characteristics of entrepreneurship and its role in economic development
- CO2: Apply the theories of achievement motivation and the principles of entrepreneurship development program
- CO3: Select the appropriate form of business ownership in setting up an enterprise.
- CO4: Apply the fundamental concepts of finance and accounting to enterprise.
- CO5: Identify sickness in industry, select the appropriate corrective measures, and identify the growth strategies in enterprise.

**Text Books**

- T1 Khanka. S.S, “Entrepreneurial Development” S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
- T2 Donald F Kuratko, “Entrepreneurships – Theory, Process and Practice”, Cengage Learning, 2014.

**References**

- R1 Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill, 2013.
- R2 Mathew J Manimala, “Entrepreneurship theory at cross roads: paradigms and praxis”, Dream tech, 2005.
- R3 Charantimath, P. M., “Entrepreneurship Development and Small Business Enterprises”, Pearson, 2006.

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CO2	1	2	2	2	2	-	-	-	-	2	-	2	2	1
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CO4	3	1	1	2	2	-	-	2	-	2	-	2	1	1
CO5	2	2	3	2	1	-	-	-	-	2	-	2	2	1
AVG	2	1.6	2	2	1.8	-	-	2	-	2	-	2.2	1.4	1

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**Course Objectives**

1. To facilitate students to learn basic embedded system in automobile.
2. To train the learners in embedded communication
3. To introduce the drive by wire technologies
4. To enhance knowledge in hardware module
5. To equip the trainers in software developments tool

**UNIT I INTRODUCTION****(9)**

Body and convenience electronics, Vehicle power supply controllers and lighting modules, Door control modules Safety electronics, Active safety systems - ABS, ASR& ESP. Passive safety systems restrained systems and their associated sensor in an automobile, Power train electronics, Petrol Engine Management, Infotainment electronics, Dashboard Instrument cluster, car audio, telematics system, navigation system, multimedia systems. Cross application technologies 42-volt vehicle power supply system

**UNIT II EMBEDDED COMMUNICATIONS****(9)**

A Review of Embedded Automotive Protocols, Dependable Automotive CAN Networks, Flex Ray Protocol.

**UNIT III DRIVE BY WIRE****(9)**

Challenges and opportunities of X by Wire: System and design requirements steer by wire, brake by wire, suspension by wire, gas by wire, power by wire, and shift by wire. Future of automotive Electronics.

**UNIT IV HARDWARE MODULES****(9)**

MC9S12XD family features Modes of operation: functional block diagram overview, Programming model Map Overview Pulse width Modulator (PWM) On chip ADC serial communication protocol SCI,SPI,IIC,CAN.

**UNIT V SOFTWARE DEVELOPMENTS TOOLS****(9)**

Introduction to HCS12XDT512 Student learning kit & PBMCU (Project board), Introduction to code warrior IDE editing, debugging simulating simple programs. Flashing code into HCS12XDT512 SLK board and testing.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the basic embedded system in automobile
- CO2: Practiced in embedded communication.
- CO3: Introduced to gain information of drive by wire technology.
- CO4: Acquired various types of hardware module.
- CO5: Gain knowledge in software developments tool

**Text Books**

- T1 William B. Ribbens, "Understanding Automotive Electronics- An Engineering Perspective", Seventh edition, Butterworth-Heinemann Publications.
- T2 Ronald K. Jurgen. "Automotive Electronics Handbook", Mc-Graw Hill.

**References**

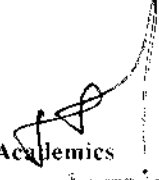
- R1 Kiencke, Uwe, Nielsen&Lars. "Automotive Control Systems for Engine, Driveline and Vehicle", Second edition, Springer Publication.
- R2 Tao Zhang, Luca Delgrossi. "Vehicle Safety Communications: Protocols, Security and Privacy", Wiley Publication.
- R3 Robert Bosch, "Automotive Hand Book", Fifth edition, SAE Publications.

CO PO MAPPING

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CO2	1	2	2	2	2	-	-	-	-	2	-	2	2	1
CO3	2	2	3	2	2	-	-	-	-	2	-	2	1	1
CO4	3	1	1	2	2	-	-	2	-	2	-	2	1	1
CO5	2	2	3	2	1	-	-	-	-	2	-	2	2	1
AVG	2	1.6	2	2	1.8	-	-	2	-	2	-	2.2	1.4	1

  
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**HICET**

**Course Objectives**

1. To get good exposure an automotive safety.
2. To understand the safety concepts.
3. To acquire knowledge in safety equipments.
4. To familiarize the concept of crash mechanism.
5. To recognize the various adjustment systems for comfort and convenience drive.

**UNIT I INTRODUCTION**

(9)

Evolution of automotive safety - Active safety: driving safety, conditional safety, perceptibility safety, operating safety- passive safety: exterior safety, interior safety, safety sandwich construction – NCAP.

**UNIT II SAFETY CONCEPTS**

(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.

**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 - Collision warning system - Central Locking system - Child safety.

**UNIT IV CRASH AND IMPACT MECHANICS**

(9)

Design of crash crumple zones - Behavior of specific body structures in crash testing - Roll over crash tests - Regulatory requirements for crash testing & testing procedure - vehicle impacts- Side and Frontal Pole Impact.

**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****Course Outcomes**

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

- CO1: Acquired the knowledge in automotive safety and importance.
- CO2: Able to analyze the safety concepts.
- CO3: Illustrate the various safety equipments functions and importance.
- CO4: Acquire knowledge on various crash test and impact test.
- CO5: Able to know the function of warning and avoidance systems.

**Text Books**

- T1 Ljubo Vlacic, Michel Parent, Fumio Harashima – “Intelligent Vehicle Technologies Theory and Applications” -Butterworth-Heinemann, 2001.
- T2 Robert Bosch GmbH - “Safety, Comfort and Convenience Systems”- Wiley; 3rd edition, 2007


**References**

- R1 ARAI Safety standards
- R2 Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.
- R3 J. Marek, H.-P. Trah, Y. Suzuki, J. Yokomori - “Sensors for Automotive Applications” -WILEY-VCH Verlag GmbH & Co. 2003

CO PO MAPPING

CO:PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	1	2	-	-	3	-	-	2	-	3	2	2
CO2	3	3	3	2	-	-	3	-	-	2	-	3	2	2
CO3	3	3	3	1	2	-	2	-	-	2	-	3	2	3
CO4	3	2	2	2	2	2	2	-	-	2	-	2	2	2
CO5	3	2	3	2	2	3	2	-	-	2	-	2	2	2
AVG	3	2.6	2.4	1.8	2	2.5	2.4	-	-	2	-	2.6	2	2.2

  
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**Course Objectives**

1. To understand Power semiconductor Operations.
2. To know about features of Power electronic Converters.
3. To discuss about the various aspects of Rectifiers & Inverters.
4. To learn the AC and DC drives.
5. To get an exposure about the case study of Electronics devices

**UNIT I AUTOMOTIVE POWER SEMI CONDUCTOR DEVICES (9)**

Power Electronic Circuits - Types, design of equipment's, RMS waveforms, peripheral effects. Power Transistors- types, operation. Diodes- types, operation and characteristics. BJT and MOSFETs- Steady state, switching characteristics. Power MOSFETs and IGBTs-importance, operations. SPICE MODELS-Diode, BJT and MOSFETs Simulation concepts.

**UNIT II AUTOMOTIVE POWER ELECTRONIC CONVERTERS (9)**

DC-DC Converters-principle, operation and characteristics. Step-Down (Buck) Converter- Step-Up (Boost) Converter- Buck-Boost Converter. Input Filter & Converters- Design considerations. SPICE MODEL- Buck Converter simulation concept.

**UNIT II RECTIFIERS AND INVERTERS (9)**

Diode Rectifiers- Single-phase, Three-phase, Poly-phase Diode Rectifiers- Rectifier circuit design. Voltage Source Inverters- Single-phase, Three-phase Voltage Source Inverters. Current Source Inverters-Inverter circuit design. SPICE MODEL- Rectifiers and Inverters simulation concepts.

**UNIT IV AC AND DC DRIVES (9)**

DC Drives-performance equations, single-phase and three phase half-wave, full, dual converter and semiconductor drives. AC Drives-Three-phase Induction Motor, various controls, DSP based Vector Control. Modeling Capabilities- Field-Oriented Control Modeling of Induction Motor Drives.

**UNIT V RECENT TRENDS AND CASE STUDIES IN POWER ELECTRONICS (9)**

Wide bandgap (WBG) semiconductors-Silicon power Transistors-design overview-Gallium Nitride Transistors-SiC Vs GaN in power switching applications-HEV/EV On board chargers Wibotic autonomous wireless charging systems-Boeing 787 Electrical Power System

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Apply the knowledge in selecting Power Semiconductor Devices for applications.  
 CO2: Demonstrate the operation and characteristics of the DC-DC Converters.  
 CO3: Analyze the operation of Rectifiers and Inverters.  
 CO4: Explain the operation of AC and DC Drives.  
 CO5: Identify different simulation packages.

**Text Books**

- T1 Rashid M.H., "Power Electronics Circuits- Devices and Applications", Pearson Education, Fourth Edition, 2014.  
 T2 Haitham Abu-Rub, Mariusz Malinowski and Kamal Al-Haddad "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications", John Wiley and sons, 2014  
 T3 Bhimbhra P.S., "Power Electronics", Khanna Publishers, 2002.

**References**

- R1 Ali Emadi, "Handbook of automotive power electronics and motor drives ", CRC Press, 2005.  
 R2 Rashid M.H., " SPICE for Power Electronics and Electric Power", CRC Press, Third Edition, New Delhi, 2012  
 R3 " New Power Electronics and Variable Frequency Drives"- IEEE Press, 1997

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	2	1	-	1	-	1	2	-	1	1	1
CO2	2	2	1	2		-	2	-	2	2	-		1	2
CO3	2	2	2			-	1	-	2	2	-		1	2
CO4	3	3	1	2	1	-	1	-	2	1	-	1	1	2
CO5	2	2	1	2	1	-		-	2	1	-		1	2
AVG	2.2	2.2	1.2	2	1		1.2		1.8	1.6		1	1	1.8

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**Course Objectives**

1. To Identify and differentiate IVS user services and its components.
2. To Select and provide appropriate IVS technology to solve real-life traffic problems
3. To Manage the traffic congestion by acquisition of big data using advanced devices.
4. To Design and implement the suitable IVS and services for effective transportation.
5. To know about the Standards and Procedures of Intelligent Vehicular Service

**UNIT I INTRODUCTION OF INTELLIGENT VEHICULAR SYSTEM****(9)**

Definitions, features and objectives of IVS, History of IVS and its development over the world, telemetric concept, Transport telemetric, telemetric structure, IVS taxonomy, IVS application areas, uses, and application overview.

**UNIT II IVS USER SERVICES****(9)**

Infrastructure based services: Arterial management and integration, freeway/highway management, crash prevention and safety, road weather management, roadway operation and maintenance, transit management, emergency management, Electronic payment and pricing, traveller information, COV, etc.,

**UNIT II IVS COMPONENTS, TOOLS AND STRATEGIES****(9)**

Components of user services: advanced traffic management system, advanced traveler information system, advanced vehicle control system, commercial vehicle operational management, advanced public transportation system, electronic payment system, advanced rural transportations, security and safety systems

**UNIT IV DESIGN AND IMPLEMENTATION****(9)**

Design components; data acquisition methods, equipment and used technology, radar and sensor, detectors, vehicle identifiers, and GPS, Communication tools; DSRC, CALM, traveler information tools, data handling, processing and management; TCM, and its working, worldwide IVS implementation and challenges, case studies.

**UNIT V IVS STANDARDS AND FUTURE SCOPE****(9)**

IVS standards, development process, legal issues, financial issues, Mainstreaming IVS; integration and up gradation; Future of IVS, case studies.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Manage a transport fleet and their related activities with improved managerial skills.  
 CO2: Maintain the services with good relationship, good behavior and trustworthiness.  
 CO3: Improve the efficiency of goods transport with minimal operational cost.  
 CO4: Perform maintenance activities in time to avoid unnecessary downtime.  
 CO5: Know about the various transport laws and motor vehicle acts.

**Text Books**

- T1 AUSTROADS, The Implication of Intelligent Transport Systems for Road Safety, Austroads Incorporated, 1999.  
 T2 Bob Williams, Intelligent Transport Systems Standards, Artech House Publishers, 2008.  
 T3 Chowdhury, M. A. and Sadek, A, Fundamentals of Intelligent Transportation Systems Planning, Artech House, 2003.


**References**

- R1 E. Bekiaris and Y.J. Nakanishi, Economic Impacts of Intelligent Transportation Systems: Innovations and Case Studies, Elsevier/JAI, 2004  
 R2 L. Vlacic, M. Parent, F. Harashima, Intelligent Vehicle Technologies – Theory and Applications, Butterworth-Heinemann, 2010.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1	2	1	-	1	-	1	-	-	1	-	-	2	2
CO2	1	1	1	-	1	-	1	-	-	1	-	-	1	2
CO3	1	1	1	-	-	-	1	-	-	1	-	-	2	1
CO4	1	1	2	-	1	-	1	-	-	-	-	1	1	1
CO5	1	1	1	-	1	-	1	-	-	-	-	1	2	2
AVG	1	1.2	1.2	-	0.8	-	1	-	-	1	-	1	1.6	1.6

  
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 - Dean - Academics  
**Dean (Academics)**  
**HiCET**

**Course Objectives**

- To get good exposure an automotive safety.
- To understand the safety concepts.
- To acquire knowledge in safety equipments.
- To familiarize the concept of crash mechanism.
- To recognize the various adjustment systems for comfort and convenience drive.

**UNIT I INTRODUCTION**

(9)

Evolution of automotive safety - Active safety: driving safety, conditional safety, perceptibility safety, operating safety- passive safety: exterior safety, interior safety, safety sandwich construction – NCAP.

**UNIT II SAFETY CONCEPTS**

(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.

**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 - Collision warning system - Central Locking system - Child safety.

**UNIT IV CRASH AND IMPACT MECHANICS**

(9)

Design of crash crumple zones - Behavior of specific body structures in crash testing - Roll over crash tests- Regulatory requirements for crash testing & testing procedure - vehicle impacts- Side and Frontal Pole Impact.

**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****Course Outcomes**

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

- CO1: Acquired the knowledge in automotive safety and importance.
- CO2: Able to analyze the safety concepts.
- CO3: Illustrate the various safety equipments functions and importance.
- CO4: Acquire knowledge on various crash test and impact test.
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- R1 ARAI Safety standards
- R2 Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.
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CO1	1	2	1	-	1	-	1	-	-	1	-	-	2	2
CO2	1	1	1	-	1	-	1	-	-	1	-	-	1	2
CO3	1	1	1	-	-	-	1	-	-	1	-	-	2	1
CO4	1	1	2	-	1	-	1	-	-	-	-	1	1	1
CO5	1	1	1	-	1	-	1	-	-	-	-	1	2	2
AVG	1	1.2	1.2	-	0.8	-	1	-	-	1	-	1	1.6	1.6

  
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**AUTO - HICET**



  
Dean - Academics

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**Course Objectives**

1. To provide knowledge about electric machines and special machine
2. To understand the basics of power converters
3. To know the concepts of controlling DC and AC drive systems
4. To understand the architecture and power train components.
5. To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)

**UNIT I ROTATING POWER CONVERTERS**

(9)

Magnetic circuits- DC machine and AC machine - Working principle of Generator and Motor-DC and AC - Voltage and torque equations – Characteristics and applications. Working principle of special machines like: Brushless DC motor, Switched reluctance motor and PMSM.

**UNIT II STATIC POWER CONVERTERS**

(9)

Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and Three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters.

**UNIT II CONTROL OF DC AND AC MOTOR DRIVES**

(9)

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives. Transformation theory, vector control operation of Induction motor and PMSM, Brushless DC motor drives. Switched reluctance motor (SRM) drives

**UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS**

(9)

History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) –Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

**UNIT V MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES**

(9)

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEVs - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power split mode - parallel mode - engine brake mode -regeneration mode - series parallel mode

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Able to understand the principles of conventional and special electrical machines.  
 CO2: Acquired the concepts of power devices and power converters  
 CO3: Able to understand the control for DC and AC drive systems  
 CO4: Learned the electric vehicle architecture and power train components  
 CO5: Acquired the knowledge of mechanics of electric vehicles and control of electric vehicles.

**Text Books**

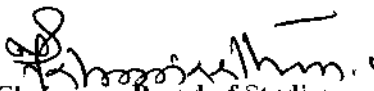
- T1 Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition, 2020.  
 T2 Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011  
 T3 Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems". 3rd Edition, Wiley-IEEE Press, 2013.

**References**


- R1 Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson. fourth Edition, 10th Impression 2021.  
 R2 Iqbal Husain, 'Electric and Hybrid Electric Vehicles'. CRC Press, 2021.  
 R3 Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1	2	1	-	1	-	1	-	-	1	-	-	2	2
CO2	1	1	1	-	1	-	1	-	-	1	-	-	1	2
CO3	1	1	1	-	-	-	1	-	-	1	-	-	2	1
CO4	1	1	2	-	1	-	1	-	-	-	-	1	1	1
CO5	1	1	1	-	1	-	1	-	-	-	-	1	2	2
AVG	1	1.2	1.2	-	0.8	-	1	-	-	1	-	1	1.6	1.6

  
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**Course Objectives**

1. To introduce students to the fundamentals of motorsports vehicle body engineering, including its historical evolution and significance in modern racing.
2. To provide students with a comprehensive understanding of structural analysis principles and design considerations for motorsports vehicle bodies.
3. To educate students about the principles and applications of aerodynamics in motorsports vehicle design.
4. To familiarize students with optimization techniques for improving the ergonomics, safety, and integration of components within motorsports vehicle bodies.
5. To explore case studies and emerging trends shaping the future of motorsports vehicle body engineering.

**UNIT 01 INTRODUCTION TO MOTORSPORTS VEHICLE BODY ENGINEERING (9)**

Overview of motorsports vehicle body engineering - Historical evolution of motorsports vehicle bodies - Importance of vehicle body design in motorsports - Aerodynamics in motorsports: fundamentals and applications - Regulations and standards governing motorsports vehicle body design

**UNIT 02 STRUCTURAL ANALYSIS AND DESIGN PRINCIPLES (9)**

Structural mechanics and its application to motorsports vehicle bodies - Material selection for motorsports vehicle body construction - Finite Element Analysis (FEA) for assessing structural integrity - Design considerations for optimizing stiffness, strength, and weight - Case studies on successful structural designs in motorsport.

**UNIT 03 AERODYNAMICS IN MOTORSPORTS (9)**

Principles of aerodynamics and its significance in motorsports - Airflow around a racing vehicle: flow visualization techniques - Front and rear aerodynamic devices: spoilers, splitters, diffusers, etc. - Computational Fluid Dynamics (CFD) simulations for aerodynamic optimization - Importance of balance between downforce and drag in vehicle performance

**UNIT 04 VEHICLE BODY OPTIMIZATION TECHNIQUES (9)**

Ergonomics and driver comfort considerations in vehicle body design - Packaging of components and systems within the vehicle body - Optimization of vehicle body for crashworthiness and safety - Integration of vehicle body with chassis and suspension systems - Advanced manufacturing techniques for producing motorsports vehicle bodies

**UNIT 05 CASE STUDIES AND FUTURE TRENDS (9)**

Analysis of iconic motorsports vehicle body designs - Examination of technological advancements shaping the future of motorsports vehicle body engineering - Emerging materials and manufacturing processes in motorsports - Sustainable practices in motorsports vehicle body engineering - Project work: Design and analysis of a motorsports vehicle body prototype

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the historical development and evolution of motorsports vehicle bodies.
- CO2: Apply structural mechanics principles to analyze and design motorsports vehicle bodies.
- CO3: Comprehend the fundamentals of aerodynamics and its relevance to motorsports.
- CO4: Able to optimize vehicle bodies for crashworthiness and safety using advanced design techniques.
- CO5: Demonstrate an understanding of sustainable practices and future directions in motorsports vehicle body design and manufacturing.

**Text Books**

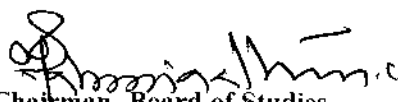
- T1 John Smith "Motorsports Vehicle Engineering: Principles and Practices" Wiley: 2020
- T2 Joseph Katz "Race Car Aerodynamics: Designing for Speed": Bentley Publishers, 2019

**References**

- R1 R. S. Vaishwanar "Principles, Methods and Modelling" Oxford University Press, 2018

### CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
CO2	1	2	-	2	2	3	3	-	-	3	-	2	2	3
CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. Understand the fundamentals of electronics relevant to motorsport applications.
2. Explore the various electronic control systems used in motorsport vehicles
3. Analyze the role of sensors and actuators in motorsport electronics.
4. Investigate data acquisition and telemetry systems for performance monitoring and analysis
5. Apply principles of reliability, safety, and efficiency to the design and implementation of motorsport electronic systems.

**UNIT I INTRODUCTION TO MOTORSPORT ELECTRONICS**

(9)

Overview of motorsport electronics-Historical perspective and evolution-Importance of electronics in modern motorsport-Basic electronic components and circuits relevant to motorsport applications-Analog and digital signals in motorsport electronics

**UNIT II ELECTRONIC CONTROL SYSTEMS IN MOTORSPORT**

(9)

Engine management systems (EMS) and their components-Transmission control systems and optimization for performance-Active aerodynamics and suspension control mechanisms- Chassis control systems, including ABS, traction control, and stability control

**UNIT III SENSORS, ACTUATORS, AND DATA ACQUISITION**

(9)

Types of sensors commonly used in motorsport-Actuators and their applications in motorsport vehicles-Principles of data acquisition for performance monitoring and analysis-Sensor data processing and real-time telemetry systems

**UNIT IV Advanced Control Strategies and Power Electronics**

(9)

PID control and its application in motorsport systems- Model-based control techniques for optimal performance- Adaptive control strategies and their benefits in motorsport applications- Power distribution and management in motorsport vehicles-High-performance energy storage systems and electric propulsion in motorsport

**UNIT V Safety, Reliability, and Motorsport Regulations**

(9)

Autonomous driving, artificial intelligence, and machine learning applications-Environmental Considerations-Human Factors and Ergonomics- Motorsport Regulations and Ethics

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Discuss current trends and emerging technologies in motorsport electronics.  
 CO2: Evaluate the performance impact of different electronic control systems in motorsport vehicles.  
 CO3: Perform hands-on tasks to troubleshoot and diagnose electronic systems in motorsport vehicles.  
 CO4: Apply advanced control strategies to address specific challenges in motorsport, such as traction control or launch control.  
 CO5: Discuss ethical considerations related to the use of electronic aids in motorsport competitions.

**Text Books**

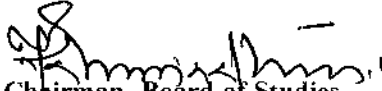
- T1 John Duke - "Motorsport Electronics: Principles and Applications" - Pearson Education, USA - 2020.  
 T2 Sarah Green - "Introduction to Automotive Electronics" - Oxford University Press, USA - 2018.  
 T3 David Smith - "Control Systems Engineering in Motorsport" - Cambridge University Press, UK - 2019.

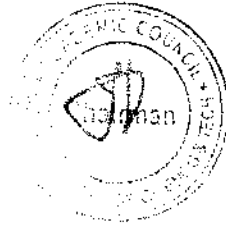
**References**


- R1 Michael Brown - "Data Acquisition and Telemetry Systems for Motorsport" - Springer, Germany - 2021.  
 R2 Emily Taylor - "Power Electronics for Motorsport Applications" - Wiley, USA - 2017.  
 R3 Steve Hood - "Chassis Engineering: Chassis Design, Building & Tuning for High Performance Handling" - HP Books, USA - 2009.

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CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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 Dean - Academics  
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**Course Objectives**

1. To understand the different types of measurement systems.
2. To know about features of transducers and terminating devices.
3. To discuss about techniques involved in measurement.
4. To learn the various experiments available in testing the engines.
5. To get an exposure about the vehicle experimental techniques.

**UNIT I MEASUREMENT SYSTEMS**

(9)

Introduction to Measurement systems-static and dynamic measurement -closed and open loop system – Requirements and characteristics – Analysis of experimental detail. Error analysis calibration of instruments

**UNIT II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICE**

(9)

Transducers for Automotive Applications – Amplifiers- filters –data Acquisition- Indicators, Printers and displays - Signal analyzer

**UNIT III MEASUREMENT TECHNIQUES**

(9)

Engine torque – wheel force -exhaust temperature – aerodynamic measurements – G force measurement • fuel flow measurements- vibration measurement – acoustic measurement.

**UNIT IV ENGINE EXPERIMENTAL TECHNIQUES**

(9)

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

**UNIT V VEHICLE EXPERIMENTAL TECHNIQUES**

(9)

Laboratory tests – Study of chassis dynamometer – test tracks – Endurance Tests – crash tests -Vehicle performance test - Brake tests.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the different types of measurement systems.  
 CO2: Know about features of transducers and terminating devices.  
 CO3: Discuss about techniques involved in measurement.  
 CO4: Learn the various experiments available in testing the engines.  
 CO5: Exposure about the vehicle experimental techniques.

**Text Books**

- T1 Crouse W H and Anglin D L., "Automotive Mechanics" Tata McGraw Hill Publishing Company, 2004  
 T2 J.G .Giles, Vehicle Operation & Testing, Volume 7 of Automotive technology series, Hiffe, 1969  
 T3 Richard D. Atkins, "An Introduction to Engine Testing and Development", SAE International 2009.

**References**

- R1 A.W. JUDGE, Engineering Precision Measurement, Chapman and Hall Ltd, Essex Street W.C., 1951.  
 R2 T.G. Beckwith and Buck, Mechanical Measurements, Oxford and IBH Publishing House, New Delhi, 1995.  
 R3 D.Patambis , Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co, New Delhi, 1990.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
CO2	1	2	-	2	2	3	3	-	-	3	-	2	2	3
CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. Understand the concept and importance of homologation in motorsport.
2. Explore the regulatory framework governing homologation processes worldwide.
3. Analyze the procedures and documentation required for vehicle and component homologation.
4. Investigate the role of testing and validation in the homologation process.
5. Apply homologation principles to practical case studies and real-world scenarios.

**UNIT I INTRODUCTION TO HOMOLOGATION**

(9)

Introduction to Homologation- Historical perspective and evolution of homologation regulations- Overview of the FIA (Fédération Internationale de l'Automobile) homologation process- Comparison of homologation requirements across different racing disciplines

**UNIT II REGULATORY FRAMEWORK**

(9)

Overview of FIA regulations and standards for vehicle and component homologation- Introduction to national and international homologation authorities- Homologation requirements for safety, performance, and environmental compliance- Case studies of homologation regulations in specific racing series

**UNIT III PROCEDURES AND DOCUMENTATION**

(9)

Detailed examination of the homologation application process- Documentation requirements for vehicle and component homologation- Procedures for conducting tests and simulations to demonstrate compliance- Role of technical delegates and scrutineers in the homologation process

**UNIT IV TESTING AND VALIDATION**

(9)

Principles of testing and validation in the context of homologation- Types of tests conducted for vehicle and component homologation- Data acquisition and analysis techniques for validating performance and safety criteria-

**UNIT V PRACTICAL APPLICATIONS AND CASE STUDIES**

(9)

Application of homologation principles to real-world scenarios and case studies - Analysis of successful and unsuccessful homologation projects in motorsport history- Case studies of testing procedures and outcomes in homologation projects

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Students will understand the importance and history of homologation in motorsport, ensuring safety, fairness, and performance in races
- CO2: Students will learn the rules and requirements for certifying vehicles and parts in motorsport, including global regulations like those set by the FIA
- CO3: Students will develop practical skills in navigating the homologation process, including preparing documentation, conducting tests
- CO4: Enhance the analytical abilities by evaluating homologation procedures and outcomes, analyzing testing data
- CO5: Students will apply their knowledge of homologation principles to practical case studies and real-world scenarios

**Text Books**

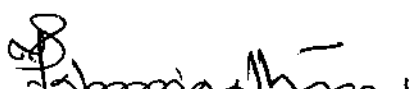
- T1 Sarah Johnson - "Understanding Motorsport Regulations" - Oxford University Press, UK - 2022.
- T2 Mark Thompson - "Homologation: A Practical Guide" - Routledge, USA - 2021.
- T3 Emily Davis - "Homologation in Motorsport: Principles and Practices" - Cambridge University Press, UK - 2022

**References**


- R1 Kevin Wilson - "FIA Homologation Handbook" - Pearson Education, USA - 2021.
- R2 Alex Roberts - "Mastering Motorsport Homologation" - McGraw-Hill Education, USA - 2022.
- R3 Rachel Green - "Homologation Essentials: A Comprehensive Guide" - Elsevier, USA - 2022.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	1	-	2	-	1	1	-	-	3	2
CO2	3	2	1	3	3	3	1	-	1	1	-	-	2	1
CO3	3	3	2	2	3	2	3	3	3	1	-	-	3	1
CO4	3	3	2	3	3	3	1	-	2	3	3	2	2	1
CO5	3	1	2	1	2	3	1	-	2	3	3	3	3	1
AVG	3	2.4	2	2.4	2.4	2.75	1.6	3	1.8	1.8	3	2.5	2.6	1.2

  
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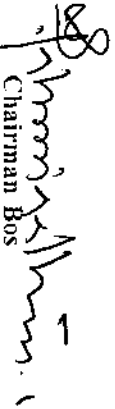


  
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**DETAILS OF COURSE REVISIONS & NEW COURSES INTRODUCED**

SYLLABUS REVISION DETAILS FOR THE REGULATION 2022 – SEMESTER I,III & V						
S.NO	COURSE CODE/COURSE NAME	SUGGESTION BY EXPERTS	EXISTING CONTENT ( IN THE AY 2023-24 ODD)	REVISED CONTENT( FOR AY 2024-25 ODD)	TYPE OF REVISION DELETION/ INSERTION/ MODIFICATION	PERCENT AGE OF REVISION
1.	22AU1201 - Fundamentals Of Automobile Engineering					
						New course being introduced in First Semester Syllabus (for the batch admitted during 2024 – 2025)
2.	22PH1153 Physical Properties Of Materials					
						New course being introduced in First Semester Syllabus (for the batch admitted during 2024 – 2025)
3.	21AU7601 - Automotive Electronics					
						New course being introduced in Seventh Semester Syllabus (for the batch admitted during 2021 – 2022)
4.	21AU7602 - Intelligent Vehicular Systems					
						New course being introduced in Seventh Semester Syllabus (for the batch admitted during 2021 – 2022)
5.	21AU7203 - Advanced Automotive Safety Systems					
						New course being introduced in Seventh Semester Syllabus (for the batch admitted during 2021 – 2022)
6.	21AU7204 - Electric Vehicle Technology					
						New course being introduced in Seventh Semester Syllabus (for the batch admitted during 2021 – 2022)
7.	21AU7205 - Motorsports Vehicle Body Engineering					
						New course being introduced in Seventh Semester Syllabus (for the batch admitted during 2021 – 2022)
8.	21AU7206 - Motorsports Race Electronics And Control Systems					
						New course being introduced in Seventh Semester Syllabus (for the batch admitted during 2021 – 2022)
9.	21AU7207 - Testing And Measurement Systems					
						New course being introduced in Seventh Semester Syllabus (for the batch admitted during 2021 – 2022)

10.	21AU7208 - Homologation	New course being introduced in Seventh Semester Syllabus (for the batch admitted during 2021 – 2022)				
11.	22AU5201 Vehicle Design And Data Characteristics	UNIT I - INTRODUCTION	UNIT I INTRODUCTION Study and selection of vehicle specifications - Choice of Cycle, fuel, speed, cylinder arrangement, method of cooling, material, design and operating variables affecting performance and emission..	UNIT I INTRODUCTION Study of vehicle specifications – Calculation of Engine power and efficiency – Performance Curve- Acceleration, Gradeability and Drawbar pull, Vehicle speed Vs. BMEP, torque and mechanical efficiency.	Deletion and inclusion of topics	30%
		UNIT II RESISTANCE TO VEHICLE MOTION	Air and Rolling Resistances at various vehicle speed, Grade Resistance, Calculation and Plotting of Driving force, Power requirement for different loads and acceleration. Maximum Power calculation.	Calculation of Air resistance, Rolling resistance and Gradient resistance against various vehicle running conditions. Relationship between engine speed and vehicle speed.	Deletion and inclusion of topics	
		UNIT III FHP AND ENGINE CAPACITY	UNIT III PERFORMANCE CURVES Torque and Mechanical Efficiency, Interpolation of Pressure – Volume diagram, Calculation of frictional Mean Effective Pressure, Calculation of Engine Cubic Capacity.	UNIT III FHP AND ENGINE CAPACITY PV diagram Theoretical and actual, Frictional Mean Effective Pressure calculation methods – Calculation of Engine Cubic Capacity.	Deletion and inclusion of topics	
12.	22AU15202 Automotive Fuels And Lubricants	Suggested to incorporate Fuel Standards	UNIT V COMBUSTION AND FUEL RATINGS	UNIT V COMBUSTION AND FUEL STANDARDS Fuel standards – Worldwide and BS Standards.	Deletion and inclusion of topics	5%
13.	22AU14201 Automotive Chassis Component Design	Suggested to incorporate Heavy vehicle	UNIT I VEHICLE FRAMES vehicle Frames, Constructional details – Materials	UNIT I VEHICLE FRAMES Light and Heavy vehicle Frames, Constructional details – Materials – Testing of frames	Inclusion of topics	5%

  
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**HINDUSTHAN**  
**COLLEGE OF ENGINEERING AND TECHNOLOGY**  
**(An Autonomous Institution)**  
**Coimbatore – 641032**

**DEPARTMENT OF AUTOMOBILE ENGINEERING**

**Curriculum and EVEN Semesters Syllabus for the Batch**

**2024 – 2028 (R2022)**

**2023 – 2027 (R2022)**

**2022 – 2026 (R2022)**

**2021 – 2025 (R2019 with Amendments)**

**(Board of Studies held on 13.12.2024)**  
**(Academic Council Meeting held on 19.12.2024)**

<b>S.No.</b>	<b>Particulars</b>	<b>Page Number</b>
1.	Vision and Mission of the Institution	01
2.	Vision and Mission of the Department & PSO's and PEO's Statements	03
3.	Program Outcomes (PO) - DEFINED BY AICTE	05
4.	Curriculum under R2022 (for the batch admitted during 2024 – 2025)	07
5.	Second Semester Syllabus (for the batch admitted during 2024 – 2025)	23
6.	Curriculum under R2022 (for the batch admitted during 2023 – 2024)	47
7.	Forth Semester Syllabus (for the batch admitted during 2023 – 2024)	30
8.	Curriculum under R2022 (for the batch admitted during 2022 – 2023)	81
9.	Sixth Semester Syllabus (for the batch admitted during 2022 – 2023)	99
10.	Sixth Semester Syllabus (for the batch admitted during 2022 – 2023) Minor & Honors	137
11.	Curriculum under R2019 with Amendments (for the batch admitted during 2021 – 2022)	153
12.	Eighth Semester Syllabus (for the batch admitted during 2021 – 2022)	165
13.	Eighth Semester Syllabus (for the batch admitted during 2021 – 2022) Minor & Honors	189
14.	Details of Course Revisions & New Courses Introduced	199



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COIMBATORE - 641032**



**VISION OF THE INSTITUTION**

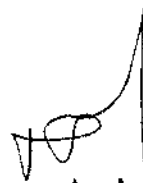
**IV1:** To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values

**MISSION OF THE INSTITUTION**

- IM1:** To provide academic excellence in technical education through novel teaching methods
- IM2:** To empower students with creative skills and leadership qualities
- IM3:** To produce dedicated professionals with social responsibility

  
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**HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY  
COIMBATORE - 641032**



**DEPARTMENT OF AUTOMOBILE ENGINEERING  
(NBA ACCREDITED)**

**VISION OF THE DEPARTMENT**

**DV1:** To produce globally competent automobile engineers with technical expertise, innovative outlook and leadership skills to serve the society with moral values

**MISSION OF THE DEPARTMENT**

**DM1:** To create professionals with the ability to design, develop and progress with the latest technology in automotive sector

**DM2:** To inculcate creativity, innovation, leadership and entrepreneurship qualities required for the automotive industry

**DM3:** To foster social responsibility and ethical behaviour for the welfare of the society

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

The graduates will be able to:

**PEO1:** Apply analytical and computational techniques to address the challenges in automotive industry

**PEO2:** Utilize their innovation, leadership skills and entrepreneurial skills to excel in their profession

**PEO3:** Exhibit professionalism, team spirit and pursue lifelong learning with social concern to achieve career and organizational goals

**PROGRAMME SPECIFIC OUTCOMES (PSOs)**

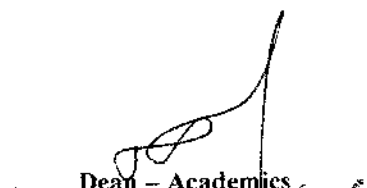
The graduates will be able to:

**PSO1:** Apply their technical knowledge and software proficiency with practical and social perspectives to succeed in the automotive sector.

**PSO2:** Solve technical challenges and produce realistic outcomes in engine management, transmission system, vehicle structure, hybrid and EV technology.

  
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COIMBATORE - 641032  
DEPARTMENT OF AUTOMOBILE ENGINEERING



**PROGRAM OUTCOMES(PO) - DEFINED BY AICTE**

PO's	Attributes	Description
PO 1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis	Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

<b>PO 8</b>	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
<b>PO 9</b>	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
<b>PO 10</b>	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.
<b>PO 11</b>	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.
<b>PO 12</b>	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.

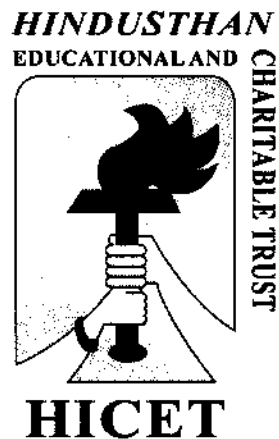
  
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***HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY***  
**(An Autonomous Institution Affiliated to Anna University, Chennai)**  
**(Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' Grade)**  
**Coimbatore - 641 032.**

**B.E. AUTOMOBILE ENGINEERING**



**CHOICE BASED CREDIT SYSTEM**

**Revised Curriculum and Syllabus for the EVEN Semester**  
**For the students admitted during the academic year 2024-2025**  
**Academic year 2024-25**

**2022 REGULATIONS**





**Hindusthan College of Engineering and Technology**  
 (An Autonomous Institution, Affiliated to Anna University, Chennai  
 Approved by AICTE, New Delhi & Accredited by NAAC with 'A++' Grade)  
 Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu.



**DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS**

**CBCS PATTERN**

**UNDERGRADUATE PROGRAMMES**

**B.E. AUTOMOBILE ENGINEERING (UG)**

**REGULATION-2022**

**For the students admitted during the academic year 2024-2025 and onwards**

**SEMESTER I**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2	22ME1201	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
3	22PH1153	Physical properties of materials	BSC	2	0	2	3	4	40	60	100
4	22HE1151	English for engineers	HSC	2	0	2	3	4	50	50	100
5	22AU1201	Fundamentals of Automobile Systems	BSC	2	0	2	3	4	50	50	100
<b>EEC COURSES (SE/AE)</b>											
6	22HE1072	ENTREPRENEURSHIP & INNOVATION (Common to all branches)	AEC	1	0	0	1	1	100	0	100
7	22HE1073	Introduction to Soft Skills	SEC	1	0	0	0	1	100	0	100
<b>MANDATORY COURSE</b>											
8.	22MC1093 22MC1094	தமிழர் மரபு / Heritage of Tamils	MC	2	0	0	1	2	0	0	0
9.	22MC1095	Universal Human Values	MC	2	0	0	0	2	0	0	0
<b>TOTAL</b>				<b>15</b>	<b>5</b>	<b>6</b>	<b>18</b>	<b>27</b>	<b>770</b>	<b>330</b>	<b>700</b>

**SEMESTER II**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total	
<b>THEORY</b>												
1	22MA2101	Differential Equations And Complex Analysis	BSC	3	1	0	4	4	40	60	100	
2	22CY2101	Environmental Studies	ESC	2	0	0	2	3	40	60	100	
3	22ME2101	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100	
<b>THEORY WITH LAB COMPONENT</b>												
4	22CY2154	Chemistry For Mechanical Sciences	HSC	2	0	2	3	4	50	50	100	
5	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100	
6	22IT2251R	Python Programming and Practices	PCC	2	0	2	3	4	50	50	100	
<b>PRACTICAL COURSES</b>												
7	22ME2001	Engineering Practices	ESC	0	0	4	2	4	60	40	100	
<b>EEC COURSES (SE/AE)</b>												
8	22HE2071	Design Thinking	AEC	2	0	0	2	2	100	0	100	
9	22HE2072	Soft Skills and Aptitude	SEC	1	0	0	1	1	100	0	100	
<b>MANDATORY COURSE</b>												
10.	22MC2094/ 22MC2095	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	MC	2	0	0	1	2	40	60	100	
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 100 hours								-
<b>TOTAL</b>				<b>19</b>	<b>1</b>	<b>10</b>	<b>24</b>	<b>26</b>	<b>570</b>	<b>430</b>	<b>1000</b>	

**SEMESTER III**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA3104	Fourier analysis and numerical techniques	BSC	3	1	0	4	4	40	60	100
2.	22AU3201	Fundamentals of Automotive Engines	PCC	3	0	0	3	3	40	60	100
3.	22AU3202	Fundamentals of Thermodynamics	PCC	3	1	0	4	3	40	60	100
4.	22AU3203	Mechanics of Materials	PCC	3	1	0	4	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5.	22AU3251	Manufacturing Technology	PCC	2	0	2	2	4	50	50	100
<b>PRACTICAL</b>											

6.	22AU3001	Automotive Components Lab	ESC	0	0	4	2	4	60	40	100
7.	22AU3002	Mechanics of Materials Lab	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE3071	Soft Skills -2	SEC	1	0	0	1	1	100	0	100
9.	22AU3072	Machine Drawing	AEC	0	0	4	2	2	60	40	100
10.	22MC3092	Essence of Indian Traditional Knowledge	AEC	2	0	0	0	0	-	-	-
<b>TOTAL</b>				<b>19</b>	<b>3</b>	<b>10</b>	<b>25</b>	<b>29</b>	<b>470</b>	<b>430</b>	<b>900</b>

### SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2.	22AU4201	Automotive Chassis components Design	BSC	3	0	0	3	3	40	60	100
3.	22AU4202	Automotive Electricals and Electronics systems	PCC	3	0	0	3	3	40	60	100
4.	22AU4203	Mechanics of Machines	PCC	3	1	0	4	4	40	60	100
5.	22AU4204	Fluid Mechanics And Actuating Systems	PCC	3	0	0	3	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU4251	Fundamentals of Heat Transfer	PCC	3	0	2	4	4	50	50	100
<b>PRACTICAL</b>											
7.	22AU4001	Automotive Electricals and Electronics Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU4002	Computer Aided Engine components design Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE4071	Soft Skills -III	SEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSE</b>											
10	22MC4091	Indian Constitution	MC	2	0	0	0	0	0	0	0
<b>TOTAL</b>				<b>20</b>	<b>1</b>	<b>10</b>	<b>24</b>	<b>29</b>	<b>460</b>	<b>440</b>	<b>900</b>

\* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same will be evaluated in Semester IV.  
If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed with Internship II (Total: 4 weeks-2 credits)

**SEMESTER V**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU5201	Vehicle design and data characteristics	PCC	3	0	0	3	4	40	60	100
2.	22AU5202	Automotive Fuels and Lubricants	PCC	3	0	0	3	3	40	60	100
3.	22AU53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	22AU53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	22AU53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU5251	Two and Three-wheeler technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
7.	22AU5001	Automotive Fuels and Lubricants Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>6</b>	<b>21</b>	<b>25</b>	<b>410</b>	<b>390</b>	<b>800</b>

**SEMESTER VI**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU6201	Vehicle Dynamics	PCC	3	0	0	3	3	40	60	100
2.	22AU6202	Automotive Emission and Pollution Control	PCC	3	0	0	3	3	40	60	100
3.	22HE6101	Professional Ethics (Common)	HSC	3	0	0	3	3	40	60	100
4.	22AU63XX	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
5.	22AU63XX	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
6.	22XX64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
7.	22AU6001	Computer Aided Engineering Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU6002	Engine Performance and Emission testing laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE6071	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
<b>TOTAL</b>				<b>20</b>	<b>0</b>	<b>8</b>	<b>24</b>	<b>28</b>	<b>460</b>	<b>440</b>	<b>900</b>

### SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU7201	Design of Automotive Transmission systems	PCC	3	0	0	3	3	40	60	100
2.	22AU7202	Engine and Vehicle Management systems	PCC	3	1	0	4	4	40	60	100
3.	22AU7203	Hybrid and Electric Vehicle Technology	PCC	3	0	0	3	3	40	60	100
4.	22AU73XX	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
5.	22XX7401	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
6.	22AU7001	Vehicle Maintenance Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
7.	22AU7701	Internship - II*	SEC	-	-	-	2	1	100	0	100
<b>TOTAL</b>				<b>15</b>	<b>1</b>	<b>4</b>	<b>20</b>	<b>21</b>	<b>360</b>	<b>340</b>	<b>700</b>
* - Two weeks internship carries 1 credit and it will be done during Semester VI summer vacation/placement training and same will be evaluated in Semester VII.											

### SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>EEC COURSES (SE/AE)</b>											
1.	22AU8901	Project Work/Granted Patent	SEC9	0	0	20	10	20	100	100	200
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>	<b>20</b>	<b>100</b>	<b>100</b>	<b>200</b>

**Note:**

1. \*As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22.

### SEMESTER-WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	-	-	-	-	-	20
3	ESC	6	5	2	-	-	-	-	-	15
4	PCC	-	-	16	20	12	10	12	-	64
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	3	3	-	12
7	EEC	2	3	3	1	1	2	2	10	25
8	MCC	✓	✓	-	-	-	-	-	-	-
<b>Total</b>		<b>18</b>	<b>22</b>	<b>25</b>	<b>24</b>	<b>21</b>	<b>24</b>	<b>20</b>	<b>10</b>	<b>165</b>

### OPEN ELECTIVE I (EMERGING TECHNOLOGIES)

Students must choose an open elective course from the given list. The content of the course should not be related to their current program of study.

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6401	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3
2	22CS6401	Block chain Technology Fundamentals	OEC	3	0	0	3	3
3	22EC6402	IoT Concepts and Applications	OEC	3	0	0	3	3
4	22IT6401	Data Science and Analytics Fundamentals	OEC	3	0	0	3	3
5	22BM6401	3D printing	OEC	3	0	0	3	3
6	22AE6401	Space Science	OEC	3	0	0	3	3
7	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
8	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
9	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
10	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
11	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
12	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
13	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
14	22AU6401	Basics of Automobile Engineering	OEC	3	0	0	3	3
15	22EF6401	Fundamentals of Electric vehicles	OEC	3	0	0	3	3
16	22FT6401	Traditional Foods	OEC	3	0	0	3	3

17	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
18	22CH6401	Waste to Energy conversion	OEC	3	0	0	3	3
19	22LS7407	NCC Level - I	OEC	3	0	0	3	3

## OPEN ELECTIVE II

### LIFE SKILL COURSES

Students shall choose any one of the Life Skill courses from the open elective courses listed below.

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3
8	22LS7408	Cybercrime and Awareness	OEC	3	0	0	3	3
9	22LS7409	First Aid and Emergency care	OEC	3	0	0	3	3
10	22LS7410	Business Communication	OEC	3	0	0	3	3

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1 Modern Mobility Systems	Vertical 2 Product and Process Development	Vertical 3 Robotics and Automation	Vertical 4 Digital and Green Manufacturing	Vertical 5 Clean and Green Energy Technologies	Vertical 6 Core Elective
22AU5301 Automotive Materials, Design and Testing	22AU5304 Value Engineering	22AU5307 Sensors and Instrumentation	22AU5310 Digital Manufacturing and IoT	22AU5313 Bioenergy Conversion Technologies	22AU5316 Automotive Chassis
22AU5302 Futuristic Vehicle Technology	22AU5305 Additive Manufacturing	22AU5308 Electrical Drives and Actuators	22AU5311 Lean Manufacturing	22AU5314 Solar Thermal Technology	22AU5317 Automotive Transmission
22AU5303 Renewable Energy and Emission Control Technology for Off Road Vehicles	22AU5306 CAD/CAM	22AU5309 Embedded Systems and Programming	22AU5312 Modern Robotics	22AU5315 Energy Conservation in Industries	22AU5318 Alternate Fuels and Energy Systems

22AU6301 Vehicle Health Monitoring, Maintenance and Safety	22AU6303 Ergonomics in Design	22AU6305 Robotics	22AU6307 Green Manufacturing Design and Practices	22AU6309 Wind Energy Technology	22AU6311 Automotive Engine Components design
22AU6302 Autonomous and connected vehicle	22AU6304 New Product Development	22AU6306 Smart Mobility and Intelligent Vehicles	22AU6308 Environment Sustainability and Impact Assessment	22AU6310 Renewable Energy Technologies	22AU6312 Finite Element Analysis
22AU7301 Thermal Management of Batteries and Fuel Cells	22AU7302 Product Life Cycle Management	22AU7303 Haptics and Immersive Technologies	22AU7304 Green Supply Chain Management	22AU7305 Equipment for Pollution Control	22AU7306 Principles of Management

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

#### Details of Vertical I: MODERN MOBILITY SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5301	Automotive Materials, Design and Testing	PEC	3	0	0	3	3
2	22AU5302	Futuristic Vehicle Technology	PEC	3	0	0	3	3
3	22AU5303	Renewable Energy and Emission Control Technology for Off Road Vehicles	PEC	3	0	0	3	3
4	22AU6301	Vehicle Health Monitoring, Maintenance and Safety	PEC	3	0	0	3	3
5	22AU6302	Autonomous and connected Vehicle	PEC	3	0	0	3	3
6	22AU7301	Thermal Management of Batteries and Fuel Cells	PEC	3	0	0	3	3

#### Details of Vertical II: PRODUCT AND PROCESS DEVELOPMENT

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5304	Value Engineering	PEC	3	0	0	3	3
2	22AU5305	Additive Manufacturing	PEC	3	0	0	3	3
3	22AU5306	CAD/CAM	PEC	3	0	0	3	3
4	22AU6303	Ergonomics in Design	PEC	3	0	0	3	3
5	22AU6304	New Product Development	PEC	3	0	0	3	3

6	22AU7302	Product Life Cycle Management	PEC	3	0	0	3	3
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**Details of Vertical III: ROBOTICS AND AUTOMATION**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5307	Sensors and Instrumentation	PEC	3	0	0	3	3
2	22AU5308	Electrical Drives and Actuators	PEC	3	0	0	3	3
3	22AU5309	Embedded Systems and Programming	PEC	3	0	0	3	3
4	22AU6305	Robotics	PEC	3	0	0	3	3
5	22AU6306	Smart Mobility and Intelligent Vehicles	PEC	3	0	0	3	3
6	22AU7303	Haptics and Immersive Technologies	PEC	3	0	0	3	3

**Details of Vertical IV: DIGITAL AND GREEN MANUFACTURING**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5310	Digital Manufacturing and IoT	PEC	3	0	0	3	3
2	22AU5311	Lean Manufacturing	PEC	3	0	0	3	3
3	22AU5312	Modern Robotics	PEC	3	0	0	3	3
4	22AU6307	Green Manufacturing Design and Practices	PEC	3	0	0	3	3
5	22AU6308	Environment Sustainability and Impact Assessment	PEC	3	0	0	3	3
6	22AU7304	Green Supply Chain Management	PEC	3	0	0	3	3

**Details of Vertical V: CLEAN AND GREEN ENERGY TECHNOLOGIES**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5313	Bioenergy Conversion Technologies	PEC	3	0	0	3	3
2	22AU5314	Solar Thermal Technology	PEC	3	0	0	3	3
3	22AU5315	Energy Conservation in Industries	PEC	3	0	0	3	3
4	22AU6309	Wind Energy Technology	PEC	3	0	0	3	3
5	22AU6310	Renewable Energy Technologies	PEC	3	0	0	3	3
6	22AU7305	Equipment for Pollution Control	PEC	3	0	0	3	3

**Details of Vertical VI: CORE ELECTIVE**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5316	Automotive Chassis	PEC	3	0	0	3	3
2	22AU5317	Automotive Transmission	PEC	3	0	0	3	3
3	22AU5318	Alternate Fuels and Energy Systems	PEC	3	0	0	3	3
4	22AU6311	Automotive Engine Components design	PEC	3	0	0	3	3
5	22AU6312	Finite Element Analysis	PEC	3	0	0	3	3
6	22AU7306	Total Quality Management	PEC	3	0	0	3	3

**Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

**Clause 4.10** of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

**VERTICALS FOR MINOR DEGREE**

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

Note: Each programme should provide verticals for minor degree

Minor Degree - Automotive Vehicle Technology (Offered by Automobile Engineering)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5471	Automotive Engines	3	0	0	3	40	60	100
2	22AU6471	Automotive Chassis	3	0	0	3	40	60	100
3	22AU6472	Automotive Transmission	3	0	0	3	40	60	100
4	22AU7471	Automotive Electronics	3	0	0	3	40	60	100
5	22AU7472	Intelligent vehicular systems	3	0	0	3	40	60	100
6	22AU8471	Electric and Hybrid vehicles	3	0	0	3	40	60	100

**Minor Degree - Fintech and Block Chain (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CS5601	Financial Management	3	0	0	3	40	60	100
2	22CS5602	Fundamentals of Investment	3	0	0	3	40	60	100
3	22CS5603	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	22CS5604	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	22CS5605	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	22CS5606	Introduction to Fintech	3	0	0	3	40	60	100

**Minor Degree - Entrepreneurship (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22BA5601	Foundation of Entrepreneurship	3	0	0	3	40	60	100
2	22BA6601	Introduction to Business Venture	3	0	0	3	40	60	100
3	22BA6602	Team Building & Leadership Management for Business	3	0	0	3	40	60	100
4	22BA7601	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100
5	22BA7602	Principles of Marketing Management for Business	3	0	0	3	40	60	100
6	22BA8601	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100

**Minor Degree - Environment and Sustainability (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CEXXXX	Sustainable infrastructure Development	3	0	0	3	40	60	100
2	22CEXXXX	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
3	22CEXXXX	Sustainable Bio Materials	3	0	0	3	40	60	100
4	22CEXXXX	Materials for Energy Sustainability	3	0	0	3	40	60	100
5	22CEXXXX	Green Technology	3	0	0	3	40	60	100
6	22CEXXXX	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100

Honors Degree - Electric and hybrid vehicle development									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5371	Fundamentals of Electric and Hybrid Vehicles	3	0	0	3	40	60	100
2	22AU6371	Battery Technology	3	0	0	3	40	60	100
3	22AU6372	Automotive Embedded Systems	3	0	0	3	40	60	100
4	22AU7371	Advanced Automotive Safety Systems	3	0	0	3	40	60	100
5	22AU7372	Special Purpose Electric Vehicle	3	0	0	3	40	60	100
6	22AU8371	Energy Storage Techniques for Electric Vehicle	3	0	0	3	40	60	100
Honors Degree - Motorsport Engineering									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5372	Composite Structure	3	0	0	3	40	60	100
2	22AU6373	High performance engine design	3	0	0	3	40	60	100
3	22AU6374	Motorsports Electric Vehicle	3	0	0	3	40	60	100
4	22AU7373	Motorsports Vehicle Body Engineering	3	0	0	3	40	60	100
5	22AU7374	Motorsports Race Electronics and Control Systems	3	0	0	3	40	60	100
6	22AU8372	Motorsports racing circuits and Design	3	0	0	3	40	60	100
Honors Degree - Vehicle Development and Validation									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5373	Automotive Product Design and Development	3	0	0	3	40	60	100
2	22AU6375	Noise, Vibration and Harshness	3	0	0	3	40	60	100
3	22AU6376	Automotive Instrumentation	3	0	0	3	40	60	100
4	22AU7375	Testing and Measurement Systems	3	0	0	3	40	60	100
5	22AU7377	Homologation	3	0	0	3	40	60	100
6	22AU8373	Automotive Prototyping	3	0	0	3	40	60	100

### CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	24	21	24	20	10	165

\* Student can earn extra credit 35 over and above the total credits

**ADDITIONAL CREDIT COURSE FOR NCC CADETS**

S.No	Course code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1	22HE1074	NCC General and National Integration	VA	1	0	0	1	100	0	100
2	22HE2074	Social Services and Community Development	VA	1	0	0	1	100	0	100
3	22HE3074	Leadership Qualities and Camp Activities	VA	1	0	0	1	100	0	100
4	22HE4074	General awareness, communication and Aero engines	VA	1	0	0	1	100	0	100

**ADDITIONAL CREDIT COURSE FOR AUTOMOBILE ENGINEERING**

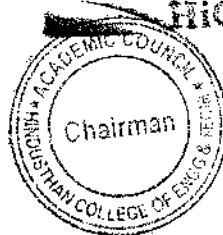
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1	22VAAU01	Foundry Technology	VA	30 hrs	Internal	1
2	22VAAU02	Forming and Shaping of Plastics	VA	30 hrs	Internal	1
3	22VAAU03	Microcontroller Programming in Automotive applications	VA	30 hrs	Internal	1
4	22VAAU04	Vehicle development and testing regulations (ARAI)	VA	30 hrs	Internal	1
5	22VAAU05	Bigdata Analysis	VA	30 hrs	Internal	1
6	22VAAU06	Data mining	VA	30 hrs	Internal	1
7	22VAAU07	Fire and safety Engineering	VA	30 hrs	Internal	1
8	22VAAU08	Introduction to MS office	VA	30 hrs	Internal	1
9	22VAAU09	Advanced Automotive Electrical and Electronics	VA	30 hrs	Internal	1
10	222VAAU10	Autodesk Fusion 360	VA	30 hrs	Internal	1

**Note: Non Credit Course results will not consider for Award of Degree**

*[Signature]*  
 Chairman, Board of Studies  
**Chairman - BoS**  
**AUTO - HICET**

*[Signature]*  
 Dean - Academics  
**Dean (Academics)**  
**HICET**

*[Signature]*  
**Principal**





Course Code	Name of the Course	L	T	P	C
22MA2101	DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS	3	1	0	4

### Course Objective

The learner should be able to

1. Describe some methods to solve different types of first order ordinary differential equations.
2. Understand the various approach to find general solution of the ordinary differential equations of second order.
3. Form the various types of Partial differential equations and methods to find solution.
4. Identify analytic functions and its properties.
5. Understand Cauchy's theorem and its applications in evaluation of integral.

Unit	Description	Instructional Hours
	<b>ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER</b>	
I	Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, Bernoulli equation.	12
	<b>LINEAR DIFFERENTIAL EQUATIONS OF SECOND ORDER</b>	
II	Second order linear differential equations with constant with RHS of the form $e^{ax}$ , $x^n$ , $\sin ax$ , $\cos ax$ , $e^{ax}f(x)$ - Cauchy's linear equations - Method of variation of parameters.	12
	<b>PARTIAL DIFFERENTIAL EQUATIONS</b>	
III	Formation of partial differential equations by eliminating arbitrary constants and functions - Solution of first order partial differential equations of the form $f(p,q)=0$ , Clairaut's equation - Lagrange's equation.	12
	<b>COMPLEX DIFFERENTIATION</b>	
IV	Functions of complex variables - Analytic functions - Cauchy's - Riemann equations and sufficient conditions (excluding proof) - Construction of analytic functions - Milne - Thomson's method - Conformal mapping $w = Az + B$ , $1/z$ and bilinear transformations.	12
	<b>COMPLEX INTEGRATION</b>	
V	Cauchy's integral theorem (Problems only) - Cauchy's integral formula - Taylor's and Laurent's series (statement only) - Residues - Cauchy's Residue theorem - Contour Integration with unit circle only.	12
	<b>Total Instructional Hours</b>	<b>60</b>

### Course Outcome

At the end of the course, the learner will be able to

- CO1: Apply methods to solve different types of first order differential equations.  
 CO2: Evaluate the solutions of second order ordinary differential equations and its properties.  
 CO3: Compute the solution of first order partial differential equations.  
 CO4: Discuss the concept of analytic functions and discuss its properties.  
 CO5: Evaluate various integrals by using Cauchy's residue theorem and derive Laurent series expansion

#### TEXT BOOKS:

- T1 - Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2019.  
 T2 - William E. Boyce, Richard C. DiPrima, Douglas B. Meade, Elementary Differential Equations, Wiley, 2017.  
 T3 - Veerarajan T, "Engineering Mathematics ". McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016.

#### REFERENCE BOOKS:


- R1 - James Ward Brown, Ruel Vance Churchill, Complex Variables and Applications, McGraw-Hill Higher Education, 2004  
 R2 - Dennis Zill, Warren S. Wright, Michael R. Cullen, Advanced Engineering Mathematics, Jones & Bartlett Learning, 2011  
 R3 - Ian N. Sneddon, Elements of Partial Differential Equations, Courier Corporation, 2013

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2	2	1	1	-	-	1	-	2	3	2
CO2	3	3	3	2	2	1	1	-	-	1	-	2	3	2
CO3	3	3	3	3	3	1	-	-	-	1	-	2	3	2
CO4	3	3	3	2	2	1	-	-	-	1	-	2	3	2
CO5	3	3	3	3	3	1	-	-	-	1	-	2	3	2
AVG	3	3	3	2.4	2.4	1	1			1		2	3	2

  
 Chairman, Board of Studies  
**Chairman - BoS**  
**AUTO - HICET**



  
 Dean - Academics  
**Dean (Academics)**  
**HICET**

Course  
Code

Name of the Course

L T P C

22CY2101

ENVIRONMENTAL STUDIES

2 0 0 2

Course Objective

1. Introduce the basic concepts of environment, ecosystems, and biodiversity and emphasize on the biodiversity of India and its conservation.
2. Impart knowledge on the causes, effects, and control or prevention measures of environmental pollution and natural disasters.
3. Facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation, and measures to preserve them.
4. Gain knowledge on the scientific, technological, economic and political solutions to environmental problems.
5. Familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit, and the challenges of environmental management.

Unit

Description

Instructional  
Hours

**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**

Scope and objectives of environmental studies -Importance of environment – need for public awareness - Eco-system and Energy flow–ecological succession- Structure and function of the forest and ponds ecosystem – Types of biodiversity:– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity: Insitu and ex-situ.

6

**UNIT II ENVIRONMENTAL POLLUTION**

Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- Nuclear hazards – role of an individual in prevention of pollution.

6

**UNIT III RENEWABLE SOURCES OF ENERGY**

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

6

**SOCIAL ISSUES AND THE ENVIRONMENT**

From unsustainable to sustainable development – urban problems related to energy- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones.

6

**SUSTAINABILITY AND MANAGEMENT**

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols. Sustainable Development Goals-targets, indicators and intervention areas. Climate change- Global, Regional, and local environmental issues and possible solutions (global warming, acid rain and ozone layer depletion). Concept of Carbon Footprint.

6

**Total Instructional Hours**

**45**

CO1: Recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.  
CO2: Identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

Course  
Outcome

CO3: Identify and apply the understanding of renewable and non-renewable resources and contribute to sustainable measures to preserve them for future generations.

CO4: Demonstrate an appreciation for need for sustainability, management and understand the various social issues and solutions to solve the issues.

CO5: Recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

**TEXTBOOKS**

T1 - Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.

T2 - Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.


**REFERENCES**

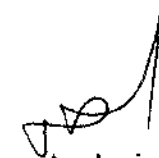
R1 – Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.

R2 - Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

**CO PO MAPPING**

/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	1	-	-	-	2	3	-	-	-	-	2	3	2
CO2	3	2	-	-	-	3	3	-	-	-	-	2	3	2
CO3	3	-	1	-	-	2	2	-	-	-	-	2	3	2
CO4	3	2	1	1	-	2	2	-	-	-	-	2	3	2
CO5	3	2	1	-	-	2	2	-	-	-	-	1	3	2
AVG	2.8	1.8	1	1	-	2.2	2.4	-	-	-	-	1.8	3	2

  
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Course Code	Name of the Course	L	T	P	C
22ME2101	ENGINEERING MECHANICS	3	0	0	3

**Course Objective**

**The student should be able**

1. To understand basic concepts and force systems in a real world environment.
2. To understand the static equilibrium of particles and rigid bodies both in two dimensions.
3. To understand the moment of surfaces and solids.
4. To understand the effect of static friction on equilibrium.
5. To understand the dynamic equilibrium equation.

Unit	Description	Instructional Hours
	<b>STATICS OF PARTICLES</b>	
I	Introduction to engineering mechanics - Classifications, force vector, Law of mechanics, System of forces, transmissibility, Force on a particle – resultant of two forces and several concurrent forces – resolution of a force – equilibrium of a particle — forces in space – equilibrium of a particle in space..	9
	<b>EQUILIBRIUM OF RIGID BODIES</b>	
II	Free body diagram, moment of a force – varignon’s theorem – moment of a couple – resolution of a force and a couple. Support reactions of the beam.	9
	<b>CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA</b>	
III	Centroids of simple plane areas, composite areas. determination of moment of inertia of composite plane figures, polar moment of inertia-radius of gyration – mass moment of inertia of simple solids.	9
	<b>FRICITION</b>	
IV	Laws of dry friction – angles of friction- angle of repose-coefficient of static and kinetic friction— Friction in inclined plane. Ladder friction, Screw friction–rolling resistance – belt friction.	9
	<b>DYNAMICS OF PARTICLES</b>	
V	Rectilinear and Curvilinear motion, -Newton’s II law– D’Alembert’s principle- Energy - potential energy kinetic energy-conservation of energy-work done by a force - work energy method, Impulse momentum method. Impact of bodies, Translation and rotation of the particles.	9
	<b>TOTAL INSTRUCTIONAL HOURS</b>	<b>45</b>

<b>Course Outcome</b>	At the end of the course, the learner will be able to
	CO1: Define and illustrate the basic concepts of force system.
	CO2: Identify the resultant force and couple, support reactions of the beam.
	CO3: Calculate the Centre of gravity and moment of inertia of an object.
	CO4: Examine the friction force of particles and objects for Impending Motion.
	CO5: Determine the Displacement, velocity and acceleration of particles and objects

**TEXT BOOKS:**

- T1. F.P.Beer, and Jr. E.R.Johnston., “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 11th Edition, Tata McGraw-Hill Publishing company, New Delhi (2018).
- T2. NH.Dubey, “Engineering Mechanics”. Tata Meraw Hill, New Delhi, 2016.

**REFERENCE BOOKS:**

1. R.C.Hibbeller, and Ashok Gupta, “Engineering Mechanics: Statics and Dynamics”, 11<sup>th</sup> Edition, Pearson Education 2010.
2. S.S.Bhavikatti, and K.G.Rajashkarappa, “Engineering Mechanics”, New Age International (P) Limited Publishers, 2015.
3. P. JagetBabu, “Engineering Mechanics”. Pearson Education, India Ltd, 2016.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	-	2	1	1	-	-	-	-	1	3	2
CO2	3	2	2	-	2	1	-	-	-	-	-	1	3	2
CO3	3	2	2	-	2	1	1	-	-	-	-	1	3	2
CO4	3	2	2	2	2	1	-	-	-	-	-	1	3	2
CO5	3	2	2	-	2	1	-	-	-	-	-	1	3	2
AVG	3	2	2	2	2	1	1	-	-	-	-	1	3	2

  
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Course Code	Name of the Course	L	T	P	C
22CY2154	CHEMISTRY FOR MECHANICAL SCIENCES	2	0	2	3

#### Course Objective

1. Sound understanding of water quality parameters and water treatment techniques.
2. The principles of electrochemistry and the mechanism of corrosion and its control.
3. The understanding of principles and significance of nanochemistry, including the unique properties of nanoscale materials compared to bulk materials, and familiarize students with various methods for synthesizing nanomaterials.
4. A detailed understanding of the key components of batteries and familiarize students with various battery types.
5. The types of fuels, calorific value calculations, manufacture of various types of fuels.

Unit	Description	Instructional Hours
	<b>WATER SCIENCE</b>	
I	Impurities in Water, Hardness of Water and Boiler feed Water – Boiler troubles -Sludge and scale formation, Caustic embrittlement, priming and foaming, boiler corrosion - - Softening Methods - Ion-Exchange Method, Desalination of Brackish Water - Reverse Osmosis. <b>Estimation of hardness of water by EDTA. Determination of Dissolved Oxygen in sewage water by Winkler's method. Estimation of alkalinity of water sample by indicator method.</b>	6+9=15
	<b>ELECTROCHEMISTRY AND CORROSION</b>	
II	Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only). Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types –galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods - protective coatings – paints – constituents and functions. <b>Determination of rate of corrosion of mild steel by weight loss method. Estimation of Ferrous iron by Potentiometry.</b>	6+6=12
	<b>NANOCHEMISTRY</b>	
III	Introduction, size-dependent properties of nanomaterial (surface area, catalytical and thermal), synthesis of nanoparticles by sol-gel, and co-precipitation method. Nanomaterials: Introduction, properties and engineering applications of carbon nanotubes and graphene.	6
	<b>ENERGY SOURCES</b>	
IV	Batteries - Characteristics - types of batteries – primary battery (alkaline battery), secondary battery (lead acid, lithium-ion-battery)- emerging batteries – nickel-metal hydride battery, aluminum air battery, batteries for automobiles and satellites - Fuel cells (Types) – H <sub>2</sub> -O <sub>2</sub> fuel cell. Renewable Energy: Solar- solar cells, DSSC	6
	<b>FUELS</b>	
V	Fuels: Classification of fuels - coal varieties - coke manufacture (Otto-Hoffman byproduct coke oven method) - characteristics of metallurgical coke - manufacturing of synthetic petrol (Bergius process) – knocking (octane number, cetane number) - gaseous fuels - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG). Green fuels: Introduction, power alcohol, synthesis and applications of biodiesel.	6
	<b>Total Instructional Hours</b>	<b>45</b>
<b>Course Outcome</b>	CO1: Demonstrate knowledge of water quality in various industries and develop skills in analyzing water quality parameters for domestic and industrial purposes.	

CO2: Apply fundamental knowledge of corrosion protection techniques and develop skills to conduct experiments for measuring and preventing corrosion.

CO3: Identify and apply fundamental concepts of nanoscience and nanotechnology for engineering and technology applications, and to develop skills in synthesizing nanomaterials.

CO4: Study the fundamentals of energy storage devices and develop skills in constructing and experimenting with batteries.

CO5: Illustrate the various types of fuels (solid, liquid, gaseous) and their characteristics and explore alternative and renewable fuels such as biofuels, hydrogen, and synthetic fuels.

#### TEXTBOOKS

T1 - P. C. Jain & Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2018).

T2 -O. G. Palanna, "Engineering Chemistry" McGraw Hill Education India (2017).

#### REFERENCES

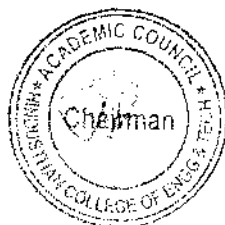
R1 – Shikha Agarwal "Engineering Chemistry -Fundamentals and Applications, Cambridge University Press, Delhi, 2019

R2 - S. S. Dara "A Textbook of Engineering Chemistry" S. Chand & Co. Ltd., New Delhi (2018).

#### CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	3	3	1	1	1	1	-	1	-	1	2	3	1
CO2	2	3	2	1	1	1	1	-	1	-	1	2	3	1
CO3	2	2	2	2	1	1	1	-	1	-	1	2	2	2
CO4	2	2	2	2	1	1	1	-	1	-	1	2	2	2
CO5	2	3	2	-	-	-	3	-	-	-	-	-	3	-
AVG	2	2.6	2.2	1.5	1	1	1.4	-	1	-	1	2	2.6	1.5

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Course Code	Name of the Course	L	T	P	C
22HE2151	EFFECTIVE TECHNICAL COMMUNICATION	2	0	2	3

### Course Objective

The learner should be able to

1. Improve essential business communication skills.
2. Enrich employability knowledge.
3. Acquire the crucial organizing ability in official forum.
4. Develop study skills and communication skills in formal and informal situations.
5. Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills

Unit	Description	Instructional Hours
I	<b>Language Proficiency:</b> Sentence Pattern, Writing definitions <b>Writing:</b> Describing product, work place and service (purpose, appearance, function) <b>Vocabulary</b> – Words on Nature <b>Practical Component:</b> <b>Listening-</b> Watching and interpreting advertisements /short films <b>Speaking-</b> Extempore / Public Speaking, Difference between Extempore / Public Speaking, Communication Guidelines for Practice	7+2
II	<b>Language Proficiency:</b> The Concept of Word Formation, Direct and Indirect Speech. <b>Writing</b> :Formal Memos, Job application and Resume preparation <b>Vocabulary</b> - Words on Offense and Ethics <b>Practical Component :</b> <b>Listening-</b> Comprehensions based on telephonic conversation <b>Speaking-</b> Vote of thanks& welcome address	7+2
III	<b>Language Proficiency:</b> Homophones and Homonyms, Question Tag <b>Writing:</b> Preparing a detail plan for an official visit, Schedule and Itinerary, Spotting Errors <b>Vocabulary</b> – Words on Society <b>Practical Component :</b> <b>Listening-</b> Listening-paraphrasing the listened content <b>Speaking-</b> Group Discussion with preparation	5+4
IV	<b>Language Proficiency:</b> Idioms, Commonly Confused Words <b>Writing:</b> Report Writing (marketing, investigating) <b>Vocabulary</b> - words involved in business <b>Practical Component:</b> <b>Listening-</b> Watching technical discussions and preparing MoM <b>Speaking-</b> On the spot Group Discussion	5+4
V	<b>Language Proficiency</b> :Relative Pronoun , Regular and Irregular verb <b>Writing:</b> Making/ Interpreting Chart, Sequencing of Sentences <b>Vocabulary-</b> Words involved in Finance <b>Practical Component:</b> <b>Listening-</b> Comprehensions based on announcements <b>Speaking-</b> Presentation on a Technical topic with ppt.	6+3
<b>Total Instructional Hours</b>		45

**Course Outcome** **At the end of the course, learners will be able to**  
 CO1: Use English Language effectively in spoken and written forms  
 CO2: Make oral and written presentation in corporate forum.  
 CO3: Acquire basic proficiency in English including reading and listening comprehension, Writing and speaking skills.  
 CO4: Take an effective role and manage in an organizational sector.  
 CO5: Prepare and demonstrate a professional presentation

**TEXTBOOKS:**

T1- Technical Communication by Gajendra Singh Chauhan and Et al, Cengage learning India Pvt Limited [Latest Revised Edition] - 2019  
 T2-Raymond Murphy, "Essential English Grammar", 5 the Edition Cambridge University Press, 2019.  
 T3-Technical Communication – Principles and Practice, Third Edition by Meenakshi Raman and Sangeetha Sharma, Oxford University Press 2017.

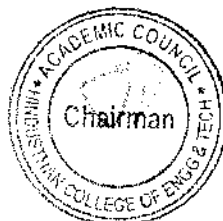
**REFERENCEBOOKS:**


R1- A Course in Technical English–D Praveen Sam, KN Shoba, Cambridge University Press – 2020  
 R2-English Language Communication Skills – Lab Manual cum Workbook, Cengage learning India Pvt Limited [Latest Revised Edition] – 2019.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1	3	3	1	1	1	1	1	1	3	1	2	1	1
CO2	1	3	2	1	1	1	1	1	1	3	1	2	1	1
CO3	1	2	2	2	1	1	1	1	1	3	1	2	1	1
CO4	1	2	2	2	1	1	1	1	1	3	1	2	1	1
CO5	1	3	2	-	-	-	3	1	-	3	-	-	1	-
AVG	1	2.6	2.2	1.5	1	1	1.4	1	1	3	1	2	1	1

  
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**Course Objectives**

1. To Understand and be aware of algorithmic problem solving
2. To read, understand and write simple Python programs
3. To develop Python functions/programs with conditionals and loops
4. To use Python data structures -- lists, tuples, dictionaries
5. To do input and output with files in Python

**UNIT I ALGORITHMIC PROBLEM SOLVING**

6

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudocode, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).  
**Illustrative problems: Finding LCM/GCD, Fahrenheit to Celsius conversion, Performing Matrix addition.**

**UNIT II DATA, STATEMENTS and CONTROL FLOW**

6

Data Types, Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if) alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass.

**Illustrative problems: Area of the polygon, check the given year is Leap year or not, Factorial of a Number, Fibonacci series generation**

**UNIT III FUNCTIONS and STRINGS**

6

Functions, parameters and arguments; Fruitful functions: return values, local and global scope, function composition, recursive functions. Strings: string slices, immutability, string functions and methods, string module.

**Illustrative programs: Perform Linear Search, Selection sort, Sum of all elements in a List, Pattern Programs**

**UNIT IV LISTS, TUPLES and DICTIONARIES**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension.  
**Illustrative programs: List and Dictionary manipulation, Finding Maximum/minimum/average in a List, String processing.**

**UNIT V FILES, MODULES and PACKAGES**

6

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages.  
**Illustrative programs: Creating/Reading/writing in a file, word count, Handling Exceptions scenarios with simple example.**

**Total Instructional Hours (Theory): 30 PERIODS**  
**Total Instructional Hours (Practical): 30 PERIODS**  
**Total Instructional Hours : 60 PERIODS**

**Course Outcomes**

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

- CO1: Design effective algorithms to solve computational problems by utilizing building blocks like statements, control flow, functions, and employing problem-solving techniques with iteration and recursion.
- CO2: Develop fundamental Python programs that utilize data types, operators, control flow with conditionals and iteration, while incorporating comments for readability.
- CO3: Construct Python functions that process and manipulate strings using parameters, return values, and understand its scope.
- CO4: Utilize Python's built-in data structures like lists, tuples, and dictionaries to effectively store, manipulate, and access data.
- CO5: Create robust Python programs that interact with the file system by reading and writing text file

**Text Books**

- T1 Guido van Rossum and Fred L. Drake Jr. - An Introduction to Python (Revised and updated for Python 3.6.2). Schroff Publishers, First edition, 2017.
- T2 S. Annadurai, S.Shankar, J.Jasmine, M.Revathi. - Fundamentals of Python Programming, Mc-Graw


Hill Education (India) Private Ltd, 2019.

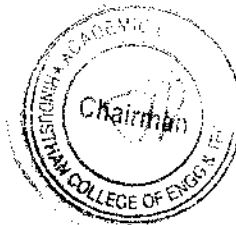
**References**


- R1 M.Sabrigiriraj, K.Manoharan – Programming Prowess: Conquering 110 coding challenges illustrated with Python code, Publisher: Hindusthan Educational Institutions, 2024
- R2 Charles Dierbach —Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	3	3	2	1	-	-	-	-	2	-	2	1	2
CO2	1	1	3	1	1	-	-	-	-	2	-	2	1	1
CO3	2	2	3	1	2	-	-	-	-	2	-	2	-	1
CO4	2	2	3	1	3	-	-	-	-	2	1	2	-	1
CO5	2	2	3	1	3	-	-	-	-	2	1	2	-	1
AVG	1.8	2	3	1.2	2	-	-	-	-	2	1	2	1	1.2

  
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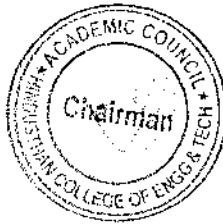
  
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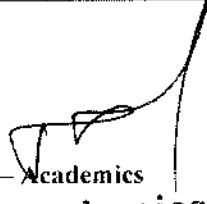
Programme	Course Code	Name of the Course	L	T	P	C
B.E/B.Tech	22ME2001	<b>ENGINEERING PRACTICES</b> (Common to all branches)	0	0	4	2
Course Objective	To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical and Electrical Engineering.					
Unit	<b>Description of the Experiments</b>					
	<b>GROUP A ( CIVIL AND MECHANICAL)</b>					
1	Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.					
2	Arrangement of bricks using English Bond for one brick thick wall for right angle corner junction and T- junction					
3	Arrangement of bricks using English Bond for one and a half brick thick wall for right angle corner and T- junction					
4	Preparation of arc welding of Butt joints, Lap joints and Tee joints.					
5	Practice on sheet metal Models– Trays and funnels					
6	Hands-on-exercise in wood work, joints by sawing, planing and cutting.					
7	Practice on simple step turning, taper turning and drilling.					
8	Demonstration on Smithy operation.					
9	Demonstration on Foundry operation.					
10	Demonstration on Power tools.					
	<b>GROUP B ( ELECTRICAL ENGINEERING)</b>					
1	Residential house wiring using switches, fuse, indicator, lamp and energy meter.					
2	Fluorescent lamp wiring.					
3	Stair case wiring.					
4	Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.					
5	Measurement of energy using single phase energy meter.					
6	Soldering practice using general purpose PCB.					
7	Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.					
8	Study of Energy Efficient Equipment's and Measuring Instruments.					
	<b>Total Instructional Hours</b>					<b>45</b>
Course Outcome	<ul style="list-style-type: none"> <li>• Fabricate wooden components and pipe connections including plumbing works.</li> <li>• Fabricate simple weld joints.</li> <li>• Fabricate different electrical wiring circuits and understand the AC Circuits.</li> </ul>					

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	3	3	1	1	1	1	-	1	-	1	2	2	2
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CO3	2	2	2	2	1	1	1	-	1	-	1	2	2	1
CO4	2	2	3	1	2	1	1	-	1	-	2	2	2	2
CO5	2	3	3	2	2	1	1	-	1	-	1	2	2	1
AVG	2	2.6	2.6	1.4	1.4	1	1		1		1.2	2	2	1.5

  
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22HE2071

## DESIGN THINKING

L	T	P	C
1	0	2	2

## Course Objective

## The student should be able to

1. To expose students to the design process
2. To develop and test innovative ideas through a rapid iteration cycle.
3. To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
I	<b>DESIGN ABILITY</b> Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	6
II	<b>DESIGNING TO WIN</b> Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	5
III	<b>DESIGN TO PLEASE AND DESIGNING TOGETHER</b> Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	6
IV	<b>DESIGN EXPERTISE</b> Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	6
V	<b>DESIGN THINKING TOOLS AND METHODS</b> Purposeful Use of Tools and Alignment with Process - Journey Mapping - Value Chain Analysis - Mind Mapping – Brainstorming - Design Thinking Application: Design Thinking Applied to Product Development	7
<b>Total</b>		<b>30</b>

## Course Outcome

## After completion of the course the learner will be able to

- CO1: Develop a strong understanding of the Design Process  
 CO2: Learn to develop and test innovative ideas through a rapid iteration cycle.  
 CO3: Develop teamwork and leadership skills

## TEXT BOOKS:

TI - 1. Nigel Cross, "Design Thinking". Kindle Edition.

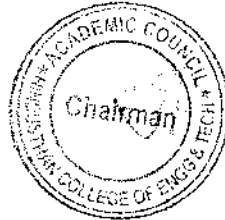
## REFERENCE BOOKS:


- R1 - Tom Kelley. "Creative Confidence", 2013.  
 R2 - 3. Tim Brown, "Change by Design", 2009.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	1	3	2	1	0	0	2	0	0	1	2	1
CO2	3	2	1	3	2	3	0	1	2	0	0	2	2	3
CO3	3	3	1	3	2	1	0	1	2	0	0	1	2	1
CO4	3	2	1	3	0	1	0	1	0	0	0	2	0	1
CO5	3	1	1	3	2	2	0	0	2	0	0	1	2	2
AVG	3	2	1	3	2	2	0	1	2	0	0	1	2	2

  
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**Dean (Academics)**  
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22HE2072

## SOFT SKILLS AND APTITUDE

L	T	P	C
1	0	0	1

**Course Objective****The student should be able to**

1. To develop and nurture the soft skills of the students through instruction, knowledge acquisition demonstration and practice.
2. To enhance the students ability to deal with numerical and quantitative skills.
3. To identify the core skills associated with critical thinking.
4. To develop and integrate the use of English language skills

Unit	Description	Instructional Hours
I	<b>Lessons on excellence</b> Skill introspection, Skill acquisition, consistent practice	2
II	<b>Logical Reasoning</b> Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	11
III	<b>Quantitative Aptitude</b> Addition and Subtraction of bigger numbers - Square and square roots - Cubes and cube roots - Vedic maths techniques - Multiplication Shortcuts - Multiplication of 3 and higher digit numbers – Simplifications - Comparing fractions - Shortcuts to find HCF and LCM - Divisibility tests shortcuts - Algebra and functions	11
IV	<b>Recruitment Essentials</b> Resume Building - Impression Management	4
V	<b>Verbal Ability</b> Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement - Punctuations	4
<b>Total Instructional Hours</b>		<b>30</b>

**After completion of the course the learner will be able to**

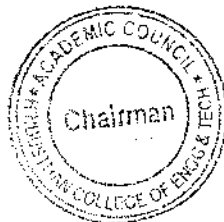
- CO1: Students will analyze interpersonal communication skills, public speaking skills.  
 CO2: Students will exemplify tautology, contradiction and contingency by logical thinking.  
 CO3: Students will be able to develop an appropriate integral form to solve all sorts of quantitative problems.  
 CO4: Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity  
 CO5: Students will be developed to acquire the ability to use English language with an error while making optimum use of grammar

Course  
Outcome

**REFERENCE BOOKS:**

- R1 - Quantitative Aptitude – Dr. R S Agarwal  
 R2 -Speed Mathematics: Secret Skills for Quick Calculation - Bill Handley  
 R3 -Verbal and Non – Verbal Reasoning – Dr. R S Agarwal  
 R4- Objective General English – S.P.Bakshi

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பாடநெறி குறியீடு  
22MC2094/2095

பாடத்தின் பெயர்  
தமிழ்நாட்டுத் தொழில்நுட்பம்

L T P C  
2 0 0 1

பாடத்தின் நோக்கம்  
கற்றவரின் இயல்வேண்டும்

1. சங்க காலத்தில் தொழில்துறை பற்றிய அறிவைப் பெறுதல்
2. சங்க காலத்தில் வீட்டின் பொருள் சிற்பங்கள் மற்றும் கோவில்கள் வடிவமைப்பு பற்றி கூட்டு கற்றல்
3. வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் அறிவை வளர்த்துக் கொள்ளுங்கள்
4. வேளாண்மை மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பண்டைய நுட்பங்களைப் பற்றிய அறிவைப் பெறுதல்
5. தமிழ் மொழியின் மென்பொருள் பற்றி அறிதல்

அலகு	விளக்கம்	பயிற்சிறை
I	<b>நெசவு மற்றும் பாளைத் தொழில்துட்பம்</b> சங்க காலத்தில் நெசவுத் தொழில் - பாளைத் தொழில்துட்பம் - கரும்பு சிவப்பு பாண்டங்கள் பாண்டங்களில் கிறல் குறியீடுகள்.	3
II	<b>வடிவமைப்பு மற்றும் கட்டிடத் தொழில்துட்பம்</b> சங்க இலக்கியத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் மற்றும் சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரம் சிற்பங்களும் கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிப்பாடுத் தளங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல் - மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டி நாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோச்செனிக் கட்டிடக் கலை.	3
III	<b>உற்பத்தி தொழில்துட்பம்</b> கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருகுதல் - வரலாற்றுசாலை சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் - கண்ணாடி மணிகள் - கடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்	3
IV	<b>வேளாண்மை மற்றும் தீர்பாசனத் தொழில்துட்பம்</b> அணை - ஏரி குளங்கள் - மதுகு - சோழர்காலக் குழுநித் தூட்டின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட திணறுகள் - வேளாண்மை மற்றும் வேளாண்மை கார்த்த செயல்பாடுகள் - கடல்சார் அறிவு - மின்வளம் - முத்து மற்றும் முத்துக் குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்	3
V	<b>அறிவியல் தமிழ் மற்றும் கணிதம்</b> அறிவியல் தமிழின் வளர்ச்சி - கணிதம் தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணைய கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்	3

மொத்த பயிற்றுவிக்கும் நேரம் 15

**பாடநெறியின் முடிவில் கற்றவர்கற்றபின்**  
பா மு: பண்டைய தொழில்துட்பத்தை அடையாளம் கொள்ள தெரியும்  
பா மு: சங்க கால கட்டுமானப் பொருட்கள் - சிற்ப வகைகளை வேறுபடுத்த முடியும்  
பா மு: வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் பட்டியலிட்டு அடையாளம் காண முடியும்  
பா மு: விவசாயம் மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பழங்கால நுட்பங்களைப் பற்றி விளக்கத்துடன் நிரூபிக்க முடியும்  
பா மு: தமிழ் மொழியின் புதிய மென்பொருள் பற்றி உருவாக்கக் கூடிய திறன் மேம்படுத்துதல்

**உரைபுத்தகங்கள்**

உ: தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை - வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்  
உ: எஸ்கே சில் இடைக்கால இந்தியாவின் வரலாறு புது தில்லி ஆக்ஸிஸ் புக்ஸ் பிரைவேட் லிமிடெட் 2011


**குறிப்புகள்**

கு: கணிதம் தமிழ் - முனைவர் இல கந்தரம் - விசுடன் பிரசுரம்

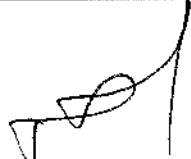
கு: சீமுடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் - தொல்லியல் துறை வெளியீடு

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	-	-	-	-	2			2
CO2	2	3	3	-	-	-	-	-	2			2
CO3	2	3	3	-	-	-	-	-	2			2
CO4	2	3	-	-	-	-	-	-	2			2
CO5	2	3	-	-	-	-	-	-	2			2
AVG	2	3	1.8	-	-	-	-	-	2			2

  
 Chairman, Board of Studies  
**Chairman - BoS**  
**AUTO - HiCET**



  
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**Course Objectives:**

The student should be able to

1. Acquiring knowledge of industry during the Sangam Period.
2. Collaborate learning about house design, sculpture and temples during Sangam Period.
3. Develop Knowledge in metallurgical studies as a source of historical and archaeological evidence.
4. Acquiring knowledge about ancient techniques used in agriculture and agro processing
5. Knowledge of Tamil language literature.

**UNIT I WEAVING AND CERAMIC TECHNOLOGY**

Weaving industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

**UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY**

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.

**UNIT III MANUFACTURING TECHNOLOGY**

Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel -Copper and gold Coins as source of history – Minting of Coins – Beads making-industries Stone beads -Glass beads – Terracotta beads -Shell beads/ bone beads – Archeological evidences – Gem stone types described in Silappathikaram.

**UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoempu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.

**UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING**

Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

**After completion of the course the learner will be able to**

- |                        |  |
|------------------------|--|
| <b>Course Outcome:</b> | CO1: Recognize ancient business  |
|                        | CO2: Distinguish Sangam period building material and types of sculpture. |
|                        | CO3: Identify the source of historical and archaeological                |
|                        | CO4: Demonstrate the techniques used in agriculture and agro processing. |
|                        | CO5: Understand the new software of Tamil language.                      |

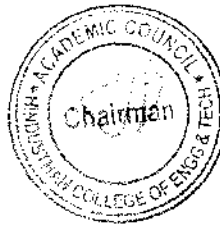
CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	-	-	-	-	2			2
CO2	2	3	3	-	-	-	-	-	2			2
CO3	2	3	3	-	-	-	-	-	2			2
CO4	2	3	-	-	-	-	-	-	2			2
CO5	2	3	-	-	-	-	-	-	2			2
AVG	2	3	1.8	-	-	-	-	-	2			2

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**Course Objectives:****The student should be able to**

1. Acquire the knowledge and active participate in social service and community development activities.
2. Understand the concept of disaster management and role of NCC cadets in disaster management.
3. Understand the concept thinking and reasoning process..
4. Understand about maps and use of bearing and service protector
5. Know about the principles of flight and Aero foil structure and ATC procedures.

Unit	Description	Instructional Hours
	<b>SOCIAL SERVICES AND COMMUNITY DEVELOPMENT</b>	
I	Basics of social services and its need - Rural development programs - Contribution of youth towards social welfare - NGOs in social services Swachbharath Abhiyan - Social evils - Mission Indradanush - BetibachoBetipado - Digital awareness - Constitution day.	3
	<b>DISASTER MANAGEMENT</b>	
II	Organization of Disaster management -Types of emergencies - Natural and manmade disasters - fire service and fire fighting - prevention of fire.	3
	<b>PERSONALITY DEVELOPMENT</b>	
III	Introduction to personality development - public speaking Intra and Inter personal skills -self awareness - critical thinking - Decision making and problem solving.	3
	<b>MAP READING</b>	
IV	Types of maps - conventional signs - scales and Grid system - relief and contour gradient - cardinal points - Types of North - types of bearing and use of service protector - Prismatic compass and its uses - setting of map - finding North and own position.	3
	<b>PRINCIPLES OF FLIGHT AND AIRMANSHIP</b>	
V	Introduction to principle of flight - Forces acting on the aircraft - Angle of attack - Angle of incidence - Newton's - law of motion - Bernauli's theorem and Venturi effect - Aerofoil - Airfield layout - ATC (Air Traffic Control) - circuit procedures - Aviation medicine.	3
	<b>Total Instructional Hours</b>	15

**Course Outcome:****After completion of the course the learner will be able to**

- CO1:Perform the social services on various occasions for better community and social life  
 CO2:Appreciate the need and requirement for disaster management and NCC role in disaster management activities.  
 CO3: Define thinking, reasoning, critical thinking and creative thinking  
 CO4:Use of bearing and service protector and locate the places and objects on the ground.  
 CO5:Understand the principles of flight and Aerofoil structure

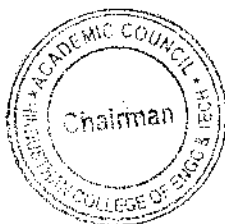
**Reference:**

1. UGC and AICTE circulated syllabus.

**Text Books :**

1. NCC cadet Guide (SD/SW) Army
2. NCC cadet Guide (SD/SW) Airforce.
3. ANOs Guide (SD/SW) by DG NCC, Ministry of Defence, New Delhi
4. Digital Forum App 1.0 & 2.0, by DG NCC DG NCC, Ministry of Defence, New Delhi

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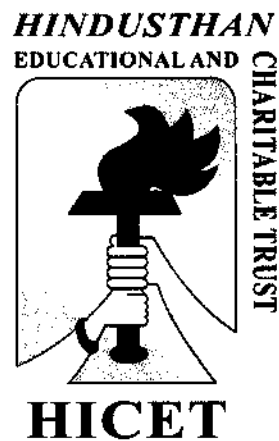


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***HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY***  
**(An Autonomous Institution Affiliated to Anna University, Chennai)**  
**(Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' Grade)**  
**Coimbatore - 641 032.**

**B.E. AUTOMOBILE ENGINEERING**



**CHOICE BASED CREDIT SYSTEM**

**Revised Curriculum and Syllabus for the EVEN Semester**  
**For the students admitted during the academic year 2023-2024**  
**Academic year 2024-25**

**2022 REGULATIONS**





**Hindusthan College of Engineering and Technology**  
 (An Autonomous Institution, Affiliated to Anna University, Chennai  
 Approved by AICTE, New Delhi & Accredited by NAAC with 'A++' Grade)  
 Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu.



**DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS**

**CBCS PATTERN**

**UNDERGRADUATE PROGRAMMES**

**B.E. AUTOMOBILE ENGINEERING (UG)**

**REGULATION-2022**

**For the students admitted during the academic year 2023-2024 and onwards**

**SEMESTER I**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2	22ME1201	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
3	22HE1151	English for Engineers	HSC	2	0	2	3	4	40	60	100
4	22PH1151	Physics for Non-Circuit Engineering	BSC	2	0	2	3	4	50	50	100
5	22IT1151	Python Programming and practices	ESC	2	0	2	3	4	50	50	100
<b>EEC COURSES (SE/AE)</b>											
6	22HE1072	ENTREPRENEURSHIP & INNOVATION (Common to all branches)	AEC	1	0	0	1	1	100	0	100
7	22HE1073	Introduction to Soft Skills	SEC	1	0	0	0	1	100	0	100
<b>MANDATORY COURSE</b>											
8.	22MC1093/ 22MC1094	தமிழர் மரபு / Heritage of Tamils	MC	2	0	0	1	2	0	0	0
9.	22MC1095	Universal Human Values	MC	2	0	0	0	2	0	0	0
<b>TOTAL</b>				<b>16</b>	<b>5</b>	<b>6</b>	<b>18</b>	<b>27</b>	<b>420</b>	<b>280</b>	<b>700</b>

**SEMESTER II**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total	
<b>THEORY</b>												
1	22MA2101	Differential equations and complex analysis	BSC	3	1	0	4	4	40	60	100	
2	22PH2101	Basics of material science	BSC	2	0	0	2	3	40	60	100	
3	22CY2101	Environmental Studies	ESC	2	0	0	2	3	40	60	100	
4	22ME2101	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100	
<b>THEORY WITH LAB COMPONENT</b>												
5	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100	
6	22CY2152	Applied Chemistry	BSC	2	0	2	3	4	50	50	100	
<b>PRACTICAL COURSES</b>												
7	22ME2001	Engineering Practices	ESC	0	0	4	2	4	60	40	100	
<b>EEC COURSES (SE/AE)</b>												
8	22HE2071	Design Thinking	AEC	1	0	2	2	2	100	0	100	
9	22HE2072	Soft Skills and Aptitude -I	SEC	1	0	0	1	1	100	0	100	
<b>MANDATORY COURSE</b>												
10.	22MC2094/ 22MC2095	தமிழரும் தொழில் துட்பமும் / Tamils and Technology	MC	2	0	0	1	2	0	0	0	
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours								-
<b>TOTAL</b>				<b>18</b>	<b>1</b>	<b>10</b>	<b>23</b>	<b>30</b>	<b>520</b>	<b>380</b>	<b>900</b>	

**SEMESTER III**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA3104	Fourier analysis and numerical techniques	BSC	3	1	0	4	4	40	60	100
2.	22AU3201	Fundamentals of Automotive Engines	PCC	3	0	0	3	3	40	60	100
3.	22AU3202	Fundamentals of Thermodynamics	PCC	3	1	0	4	3	40	60	100
4.	22AU3203	Mechanics of Materials	PCC	3	1	0	4	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5.	22AU3251	Manufacturing Technology	PCC	2	0	2	3	4	50	50	100

PRACTICAL											
6.	22AU3001	Automotive Components Lab	ESC	0	0	4	2	4	60	40	100
7.	22AU3002	Mechanics of Materials Lab	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8.	22HE3071	Soft Skills -2	SEC	1	0	0	1	1	100	0	100
9.	22AU3072	Machine Drawing	AEC	0	0	4	2	2	60	40	100
10.	22MC3092	Essence of Indian Traditional Knowledge	AEC	2	0	0	0	0	-	-	-
<b>TOTAL</b>				<b>17</b>	<b>3</b>	<b>14</b>	<b>25</b>	<b>29</b>	<b>490</b>	<b>410</b>	<b>900</b>

#### SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2.	22AU4201	Automotive Chassis components Design	BSC	3	0	0	3	4	40	60	100
3.	22AU4202	Automotive Electricals and Electronics systems	PCC	3	0	0	3	3	40	60	100
4.	22AU4203	Mechanics of Machines	PCC	3	1	0	4	4	40	60	100
5.	22AU4204	Fluid Mechanics and Actuating Systems	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6.	22AU4251	Fundamentals of Heat Transfer	PCC	3	0	2	4	4	50	50	100
PRACTICAL											
7.	22AU4001	Automotive Electricals and Electronics Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU4002	Computer Aided Engine components design Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	22HE4071	Soft Skills and Aptitude - III	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>1</b>	<b>10</b>	<b>24</b>	<b>29</b>	<b>470</b>	<b>430</b>	<b>900</b>
<p>* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same will be evaluated in Semester IV.            If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed with Internship II (Total: 4 weeks-2 credits)</p>											

**SEMESTER V**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU5201	Vehicle design and data characteristics	PCC	3	0	0	3	4	40	60	100
2.	22AU5202	Automotive Fuels and Lubricants	PCC	3	0	0	3	3	40	60	100
3.	22AU53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	22AU53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	22AU53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU5251	Two and Three-wheeler technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
7.	22AU5001	Automotive Fuels and Lubricants Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>6</b>	<b>21</b>	<b>25</b>	<b>410</b>	<b>390</b>	<b>800</b>

**SEMESTER VI**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU6201	Vehicle Dynamics	PCC	3	0	0	3	3	40	60	100
2.	22AU6202	Automotive Emission and Pollution Control	PCC	3	0	0	3	3	40	60	100
3.	22HE6101	Professional Ethics (Common)	HSC	3	0	0	3	3	40	60	100
4.	22AU63XX	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
5.	22AU63XX	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
6.	22XX64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
7.	22AU6001	Computer Aided Engineering Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU6002	Engine Performance and Emission testing laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE6071	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
<b>TOTAL</b>				<b>20</b>	<b>0</b>	<b>8</b>	<b>24</b>	<b>28</b>	<b>460</b>	<b>440</b>	<b>900</b>

### SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU7201	Design of Automotive Transmission systems	PCC	3	0	0	3	3	40	60	100
2.	22AU7202	Engine and Vehicle Management systems	PCC	3	1	0	4	4	40	60	100
3.	22AU7203	Hybrid and Electric Vehicle Technology	PCC	3	0	0	3	3	40	60	100
4.	22AU73XX	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
5.	22XX7401	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
6.	22AU7001	Vehicle Maintenance Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
7.	22AU7701	Internship - II'	SEC	-	-	-	2	1	100	0	100
<b>TOTAL</b>				<b>15</b>	<b>1</b>	<b>4</b>	<b>20</b>	<b>21</b>	<b>360</b>	<b>340</b>	<b>700</b>
* - Two weeks internship carries 1 credit and it will be done during Semester VI summer vacation/placement training and same will be evaluated in Semester VII.											

### SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>EEC COURSES (SE/AE)</b>											
1.	22AU8901	Project Work/Granted Patent	SEC9	0	0	20	10	20	100	100	200
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>	<b>20</b>	<b>100</b>	<b>100</b>	<b>200</b>

**Note:**

4. \*As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
5. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
6. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22.

**SEMESTER-WISE CREDIT DISTRIBUTION**

<b>B.E. / B.TECH. PROGRAMMES</b>										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	-	-	-	-	-	20
3	ESC	6	7	2	-	-	-	-	-	15
4	PCC	-	-	16	20	12	10	12	-	70
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	3	3	-	06
7	EEC	2	3	3	1	1	2	2	10	25
8	MCC	✓	1	-	-	-	-	-	-	-
<b>Total</b>		<b>18</b>	<b>23</b>	<b>25</b>	<b>24</b>	<b>21</b>	<b>24</b>	<b>20</b>	<b>10</b>	<b>165</b>

**OPEN ELECTIVE I (EMERGING TECHNOLOGIES)**

Students must choose an open elective course from the given list. The content of the course should not be related to their current program of study.

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6401	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3
2	22CS6401	Block chain Technology Fundamentals	OEC	3	0	0	3	3
3	22EC6402	IoT Concepts and Applications	OEC	3	0	0	3	3
4	22IT6401	Data Science and Analytics Fundamentals	OEC	3	0	0	3	3
5	22BM6401	3D printing	OEC	3	0	0	3	3
6	22AE6401	Space Science	OEC	3	0	0	3	3
7	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
8	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
9	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
10	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
11	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
12	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
13	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
14	22AU6401	Basics of Automobile Engineering	OEC	3	0	0	3	3
15	22EE6401	Fundamentals of Electric vehicles	OEC	3	0	0	3	3
16	22FT6401	Traditional Foods	OEC	3	0	0	3	3
17	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
18	22CH6401	Waste to Energy conversion	OEC	3	0	0	3	3
19	22LS7407	NCC Level - I	OEC	3	0	0	3	3

**OPEN ELECTIVE II  
LIFE SKILL COURSES**

Students shall choose any one of the Life Skill courses from the open elective courses listed below.

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3
8	22LS7408	Cybercrime and Awareness	OEC	3	0	0	3	3
9	22LS7409	First Aid and Emergency care	OEC	3	0	0	3	3
10	22LS7410	Business Communication	OEC	3	0	0	3	3

**PROFESSIONAL ELECTIVE COURSES: VERTICALS**

Vertical 1 Modern Mobility Systems	Vertical 2 Product and Process Development	Vertical 3 Robotics and Automation	Vertical 4 Digital and Green Manufacturing	Vertical 5 Clean and Green Energy Technologies	Vertical 6 Core Elective
22AU5301 Automotive Materials, Design and Testing	22AU5304 Value Engineering	22AU5307 Sensors and Instrumentation	22AU5310 Digital Manufacturing and IoT	22AU5313 Bioenergy Conversion Technologies	22AU5316 Automotive Chassis
22AU5302 Futuristic Vehicle Technology	22AU5305 Additive Manufacturing	22AU5308 Electrical Drives and Actuators	22AU5311 Lean Manufacturing	22AU5314 Solar Thermal Technology	22AU5317 Automotive Transmission
22AU5303 Renewable Energy and Emission Control Technology for Off Road Vehicles	22AU5306 CAD/CAM	22AU5309 Embedded Systems and Programming	22AU5312 Modern Robotics	22AU5315 Energy Conservation in Industries	22AU5318 Alternate Fuels and Energy Systems
22AU6301 Vehicle Health Monitoring, Maintenance and Safety	22AU6303 Ergonomics in Design	22AU6305 Robotics	22AU6307 Green Manufacturing Design and Practices	22AU6309 Wind Energy Technology	22AU6311 Automotive Engine Components design

<b>22AU6302</b> Autonomous and connected vehicle	<b>22AU6304</b> New Product Development	<b>22AU6306</b> Smart Mobility and Intelligent Vehicles	<b>22AU6308</b> Environment Sustainability and Impact Assessment	<b>22AU6310</b> Renewable Energy Technologies	<b>22AU6312</b> Finite Element Analysis
<b>22AU7301</b> Thermal Management of Batteries and Fuel Cells	<b>22AU7302</b> Product Life Cycle Management	<b>22AU7303</b> Haptics and Immersive Technologies	<b>22AU7304</b> Green Supply Chain Management	<b>22AU7305</b> Equipment for Pollution Control	<b>22AU7306</b> Principles of Management

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

#### Details of Vertical I: MODERN MOBILITY SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5301	Automotive Materials, Design and Testing	PEC	3	0	0	3	3
2	22AU5302	Futuristic Vehicle Technology	PEC	3	0	0	3	3
3	22AU5303	Renewable Energy and Emission Control Technology for Off Road Vehicles	PEC	3	0	0	3	3
4	22AU6301	Vehicle Health Monitoring, Maintenance and Safety	PEC	3	0	0	3	3
5	22AU6302	Autonomous and connected Vehicle	PEC	3	0	0	3	3
6	22AU7301	Thermal Management of Batteries and Fuel Cells	PEC	3	0	0	3	3

#### Details of Vertical II: PRODUCT AND PROCESS DEVELOPMENT

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5304	Value Engineering	PEC	3	0	0	3	3
2	22AU5305	Additive Manufacturing	PEC	3	0	0	3	3
3	22AU5306	CAD/CAM	PEC	3	0	0	3	3
4	22AU6303	Ergonomics in Design	PEC	3	0	0	3	3
5	22AU6304	New Product Development	PEC	3	0	0	3	3
6	22AU7302	Product Life Cycle Management	PEC	3	0	0	3	3

**Details of Vertical III: ROBOTICS AND AUTOMATION**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5307	Sensors and Instrumentation	PEC	3	0	0	3	3
2	22AU5308	Electrical Drives and Actuators	PEC	3	0	0	3	3
3	22AU5309	Embedded Systems and Programming	PEC	3	0	0	3	3
4	22AU6305	Robotics	PEC	3	0	0	3	3
5	22AU6306	Smart Mobility and Intelligent Vehicles	PEC	3	0	0	3	3
6	22AU7303	Haptics and Immersive Technologies	PEC	3	0	0	3	3

**Details of Vertical IV: DIGITAL AND GREEN MANUFACTURING**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5310	Digital Manufacturing and IoT	PEC	3	0	0	3	3
2	22AU5311	Lean Manufacturing	PEC	3	0	0	3	3
3	22AU5312	Modern Robotics	PEC	3	0	0	3	3
4	22AU6307	Green Manufacturing Design and Practices	PEC	3	0	0	3	3
5	22AU6308	Environment Sustainability and Impact Assessment	PEC	3	0	0	3	3
6	22AU7304	Green Supply Chain Management	PEC	3	0	0	3	3

**Details of Vertical V: CLEAN AND GREEN ENERGY TECHNOLOGIES**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5313	Bioenergy Conversion Technologies	PEC	3	0	0	3	3
2	22AU5314	Solar Thermal Technology	PEC	3	0	0	3	3
3	22AU5315	Energy Conservation in Industries	PEC	3	0	0	3	3
4	22AU6309	Wind Energy Technology	PEC	3	0	0	3	3
5	22AU6310	Renewable Energy Technologies	PEC	3	0	0	3	3
6	22AU7305	Equipment for Pollution Control	PEC	3	0	0	3	3

**Details of Vertical VI: CORE ELECTIVE**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5316	Automotive Chassis	PEC	3	0	0	3	3
2	22AU5317	Automotive Transmission	PEC	3	0	0	3	3
3	22AU5318	Alternate Fuels and Energy Systems	PEC	3	0	0	3	3
4	22AU6311	Automotive Engine Components design	PEC	3	0	0	3	3
5	22AU6312	Finite Element Analysis	PEC	3	0	0	3	3
6	22AU7306	Principles of Management	PEC	3	0	0	3	3

**Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

**Clause 4.10** of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional)

**VERTICALS FOR MINOR DEGREE**

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree. Note: Each programme should provide verticals for minor degree

**Minor Degree - Automotive Vehicle Technology (Offered by Automobile Engineering )**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5471	Automotive Engines	3	0	0	3	40	60	100
2	22AU6471	Automotive Chassis	3	0	0	3	40	60	100
3	22AU6472	Automotive Transmission	3	0	0	3	40	60	100
4	22AU7471	Automotive Electronics	3	0	0	3	40	60	100
5	22AU7472	Intelligent vehicular systems	3	0	0	3	40	60	100
6	22AU8471	Electric and Hybrid vehicles	3	0	0	3	40	60	100

**Minor Degree - Fintech and Block Chain (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CS5601	Financial Management	3	0	0	3	40	60	100
2	22CS5602	Fundamentals of Investment	3	0	0	3	40	60	100
3	22CS5603	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	22CS5604	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	22CS5605	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	22CS5606	Introduction to Fintech	3	0	0	3	40	60	100

**Minor Degree - Entrepreneurship (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22BA5601	Foundation of Entrepreneurship	3	0	0	3	40	60	100
2	22BA6601	Introduction to Business Venture	3	0	0	3	40	60	100
3	22BA6602	Team Building & Leadership Management for Business	3	0	0	3	40	60	100
4	22BA7601	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100
5	22BA7602	Principles of Marketing Management for Business	3	0	0	3	40	60	100
6	22BA8601	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100

**Minor Degree - Environment and Sustainability (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CEXXXX	Sustainable infrastructure Development	3	0	0	3	40	60	100
2	22CEXXXX	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
3	22CEXXXX	Sustainable Bio Materials	3	0	0	3	40	60	100
4	22CEXXXX	Materials for Energy Sustainability	3	0	0	3	40	60	100
5	22CEXXXX	Green Technology	3	0	0	3	40	60	100
6	22CEXXXX	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100

**Honors Degree - Electric and Hybrid Vehicle Development**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5371	Fundamentals of Electric and Hybrid Vehicles	3	0	0	3	40	60	100
2	22AU6371	Battery Technology	3	0	0	3	40	60	100

3	22AU6372	Automotive Embedded Systems	3	0	0	3	40	60	100
4	22AU7371	Advanced Automotive Safety Systems	3	0	0	3	40	60	100
5	22AU7372	Special Purpose Electric Vehicle	3	0	0	3	40	60	100
6	22AU8371	Energy Storage Techniques for Electric Vehicle	3	0	0	3	40	60	100

**Honors Degree - Motorsport Engineering**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5372	Composite Structure	3	0	0	3	40	60	100
2	22AU6373	High performance engine design	3	0	0	3	40	60	100
3	22AU6374	Motorsports Electric Vehicle	3	0	0	3	40	60	100
4	22AU7373	Motorsports Vehicle Body Engineering	3	0	0	3	40	60	100
5	22AU7374	Motorsports Race Electronics and Control Systems	3	0	0	3	40	60	100
6	22AU8372	Motorsports racing circuits and Design	3	0	0	3	40	60	100

**Honors Degree - Vehicle Development and Validation**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5373	Automotive Product Design and Development	3	0	0	3	40	60	100
2	22AU6375	Noise, Vibration and Harshness	3	0	0	3	40	60	100
3	22AU6376	Automotive Instrumentation	3	0	0	3	40	60	100
4	22AU7375	Testing and Measurement Systems	3	0	0	3	40	60	100
5	22AU7377	Homologation	3	0	0	3	40	60	100
6	22AU8373	Automotive Prototyping	3	0	0	3	40	60	100

**CREDIT DISTRIBUTION**

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	24	21	24	20	10	165

\* Student can earn extra credit 35 over and above the total credits

**ADDITIONAL CREDIT COURSE FOR NCC CADETS**


S.No	Course code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1	22HE1074	NCC General and National Integration	NA	1	0	0	1	100	0	100

2	22HE2074	Social Services and Community Development	VA	1	0	0	1	100	0	100
3	22HE3074	Leadership Qualities and Camp Activities	VA	1	0	0	1	100	0	100
4	22HE4074	General awareness, communication and Aero engines	VA	1	0	0	1	100	0	100

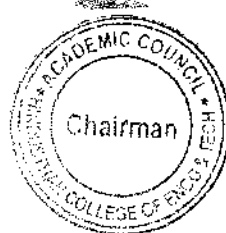
ADDITIONAL CREDIT COURSE FOR AUTOMOBILE ENGINEERING						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1	22VAAU01	Foundry Technology	VA	30 hrs	Internal	1
2	22VAAU02	Forming and Shaping of Plastics	VA	30 hrs	Internal	1
3	22VAAU03	Microcontroller Programming in Automotive applications	VA	30 hrs	Internal	1
4	22VAAU04	Vehicle development and testing regulations (ARAI)	VA	30 hrs	Internal	1
5	22VAAU05	Bigdata Analysis	VA	30 hrs	Internal	1
6	22VAAU06	Data mining	VA	30 hrs	Internal	1
7	22VAAU07	Fire and safety Engineering	VA	30 hrs	Internal	1
8	22VAAU08	Introduction to MS office	VA	30 hrs	Internal	1
9	22VAAU09	Advanced Automotive Electrical and Electronics	VA	30 hrs	Internal	1
10	22VAAU10	Autodesk Fusion 360	VA	30 hrs	Internal	1

Note: Non Credit Course results will not consider for Award of Degree

  
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 Principal





22HE4101

**IPR AND START-UPS**

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

**The student should be able****Course Objective**

1. The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.
2. To get registration in our country and foreign countries of their invention, designs and thesis or theory written by the students during their project work and for this they must have knowledge of patents, copy right,
3. To learn about the trademarks and geographical indications (GI) in our country and foreign countries of their invention.
4. To gain the knowledge about designs and layout design Act-2000.
5. To learn about the technology transfer to product and Start-up knowledge.

**Unit****Description****Instructional Hours**

Unit	Description	Instructional Hours
	<b>INTRODUCTION TO IPR</b> Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights Introduction to Trade-Related of Intellectual Property Rights (TRIPS) and World Trade Organization (WTO). - Kinds of Intellectual property rights— Copy Right, Patent, Trade Mark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge.	6
I	<b>PATENT RIGHTS AND COPY RIGHTS</b> Origin, Meaning of Patent, Types, Procedure to follow the methods of IP agents, Inventions, which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties, IT Act- introduction.	6
II	COPY RIGHT- Origin, Definition & Types of Copy Right, Patent Ethics, Registration procedure, Assignment & licence, Terms of Copy Right, Piracy, Infringement, Remedies, <b>TRADE MARKS AND GEOGRAPHICAL INDICATION</b> Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing off, Penalties.	6
III	<b>GEOGRAPHICAL INDICATION</b> – International Protection, plant varieties, Infringement of GI, licencing, legal issues.	
IV	<b>DESIGN</b> Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.	6
V	<b>START-UPS</b> Process of Innovation, Monetizing Ideas, Technology transfer to product, Funding Options for Start-up, Start-up Models. Preparation of Project Report, Start up to MNC, Start-up Audit.	6

**Total Instructional Hours**

30

63 | Page

Upon completion of the course, the students will be able to:

**Course Outcome** CO1: Understand IPR and aware the invention rights.  
 CO2: Get awareness of acquiring the patent for their project ideas  
 CO3: Learn obtaining copyright for their innovative works  
 CO4: Understand the designs and layout design Act-2000.  
 CO5: Understand the concept of start-ups, identify the required strategic resources.

**TEXT BOOK:**

- T1. Intellectual Property Rights (IPR) by M.K Bhandari 2021
- T2. Law relating to Intellectual Property Rights, by V.K Ahuja 2017
- T3. Intellectual Property Rights (IPR) for Start-ups by Vinay Vaish 2016
- T4. Intellectual Property - Patents, Copyright, Trade Marks and Allied Rights (South Asian Edition) by W Cornish and D Llewelyn and T Pain 8th South Asian Edition, 2016.
- T5 Peter Thiel & Blake Masters, Zero to One: Notes on Start Ups, or How to Build the Future, Random House, 2014.

**CO PO MAPPING**

PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	-	3	-	-	-	-	-	3	2	2
CO2	3	-	3	-	-	3	-	-	-	-	-	3	2	2
CO3	3	-	3	-	-	3	-	-	-	-	-	3	2	2
CO4	3	-	3	-	-	3	-	-	-	-	-	3	2	2
CO5	3	-	3	-	-	3	-	-	-	-	-	3	2	2
Avg.	3	-	3	-	-	3	-	-	-	-	-	3	2	2

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**Course Objectives**

1. To Introduce vehicle frames and structures along with its design elements.
2. To Broaden the understanding of components of steering systems and perform practical experiments.
3. To Impart knowledge in driveline and final drives systems with practical troubleshooting and remedies.
4. To Broaden the importance Gearbox and brake system with practical exposure.
5. To Introduce automotive suspension systems and to study its dynamic capabilities.

**UNIT I VEHICLE FRAMES****(09)**

Types of frames, materials, Layout with reference to prime mover location and drive. Frames, Constructional details – Testing of Frames – Integrated body construction- Study of loads, moments and stresses on frame members.

**UNIT II STEERING SYSTEM****(09)**

Front Axle types - Construction details – Materials - Front wheel geometry - Conditions for true rolling motion. Steering geometry - Ackermann and Davis steering - Constructional details of steering linkages - Different types of Steering gear boxes - Turning radius, wheel wobble and shimmy. Power and power assisted steering – Electric steering – Steer by wire.

**UNIT III DRIVELINE AND FINAL DRIVE****(09)**

Design of propeller shaft, Design of final drive gearing, Design of Axles, Types of wheels - Construction of wheel assembly - Types of tires and constructional details - Static and rolling properties of pneumatic tires.

**UNIT IV GEAR BOX AND BRAKING SYSTEM****(09)**

Gear box Types, Construction Details, Gear train calculations, layout of gearboxes. Design of three speed and four speed gearboxes. Types of brakes - Drum brakes and disc brakes - power assisted brakes - Retarded engine brakes, eddy retarders, Regenerative braking system – Brake by wire.

**UNIT SUSPENSION SYSTEM****(09)**

Types of suspension. Suspension springs – leaf spring, shackle and mounting brackets, coil and torsion bar springs. Spring materials, Independent suspension -- front and rear. Active suspension system. Shock absorbers – Magneto Rheological fluids.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Impart the knowledge of vehicle frame and able to design it.  
 CO2: Acquire the knowledge about steering system, its components, functions and wheel alignment along with balancing.  
 CO3: Comprehend about the various driveline systems, wheels and tires with its troubleshooting solutions.  
 CO4: Identify the suitable Gearbox based on load conditions, performance and factors with the skills  
 CO5: Interfere the automotive suspension systems with its dynamic capabilities.

**Text Books**

- T1 Kirpal Singh, "Automobile Engineering - Volume 1", Standard Publishes-Distributors, Delhi, 2017.

- T2 R.K. Rajput, "A Textbook of Automobile Engineering", Laxmi Publications Private Limited, 2018.  
 T3 N.K. Giri, "Automotive Mechanics" Khanna Publishers, New Delhi, 2010.

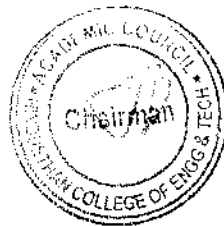
**References**

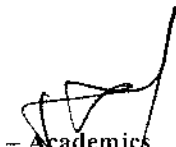
- R1 Heinz Hazler, Modern Vehicle Technology, Butterworth, London, 2005.  
 R2 Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990  
 R3 Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	1		1	1			1	1		2	2	3
CO2	3	3	1		1	1						2	2	2
CO3	3	3	1	1	1	1			1	1		2	2	3
CO4	3	2	1		1	1						2	1	2
CO5	3	2	1		1	1	1					2	1	3
AVG	3	2.6	1	1	1	1	1		1	1		2	1.6	2.6

  
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**Course Objectives**

1. To understand the fundamentals, operating principles of batteries and starting systems.
2. To illustrate the functionality of charging and lighting systems.
3. To comprehend the concepts of electronic engine controls.
4. To know about safety electronics and working principle of sensors.
5. To acquire knowledge about future automotive electronics.

**UNIT I BATTERY AND STARTING SYSTEM****(9)**

Battery – principle – Lead acid battery – characteristics - rating - efficiency of batteries – tests conducted on battery – charging methods – maintenance - free batteries - starter motor - principle - construction - drive mechanisms – maintenance – starter switches.

**UNIT II CHARGING AND LIGHTING SYSTEM****(9)**

DC generators and alternators in vehicles - cut out relay- regulators – three unit regulator - Positive & negative earth systems - vehicle interior and exterior lighting system – headlight & fog light design - Adaptive Lighting system - LED lighting system.

**UNIT III ELECTRONIC ENGINE CONTROLS****(9)**

Electronic ignition control - battery coil, magneto and electronic ignition systems – Programmed ignition - Spark plugs - electronic fuel injection - throttle body fuel injection - multi point fuel injection - gasoline direct injection - common rail direct injection - L- Jetronic fuel injection- engine mapping-on-board diagnostics.

**UNIT IV SAFETY ELECTRONICS AND SENSORS IN AUTOMOBILES****(9)**

Safety electronic systems – Anti lock braking system - Traction Control System - Electronic stability program - Cruise Control System - Microcontrollers - Sensor Sensors in automobile - sensor for speed, throttle position, exhaust oxygen level, manifold pressure, air mass flow.

**UNIT V FUTURE AUTOMOTIVE ELECTRONIC SYSTEMS****(9)**

Electric and Hybrid vehicles - Collision Avoidance - Radar warning Systems - Heads Up display - Navigation – Navigation Sensors - Radio Navigation - Signpost navigation - dead reckoning navigation - Voice Recognition Cell Phone dialing - Automatic driving Control - Key less entry system.

Case study: Implementation of IoT in Autonomous Vehicles.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the functions of batteries and charging system.  
 CO2: Know about the charging and lighting system.  
 CO3: Organize the fundamentals of electronic engine controls.  
 CO4: Make use of the safety electronics.  
 CO5: Analyze the future automotive electronics systems.

**Text Books**


- T1 Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007. ISBN No: 9783658017835  
 T2 Tom Denton., "Automobile Electrical and Electronics Systems". Elsevier Butterworth-Heinemann Linacre House, 2004.  
 T3 Judge. A.W., "Modern Electrical Equipment of Automobiles", Chapman & Hall, London, 1992.

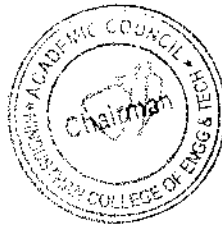
**References**

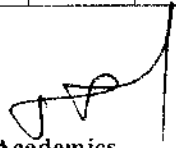
- R1 Barry Holebeak, "Automotive Electrical and Electronics", Delmar Publishers, Clifton Park, USA, 2010  
 R2 William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective." 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.  
 R3 James D Halderman, "Automotive Electrical and Electronics", Prentice Hall, USA, 2013

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	2	2	2	1	3	2	3	2	3	3
CO2	2	2	3	3	2	2	1	1	3	1	2	2	2	2
CO3	3	2	3	3	2	1	1	1	1	1	1	1	2	2
CO4	3	3	3	3	2	2	1	1	2	2	3	3	3	3
CO5	3	3	3	3	2	2	2	1	2	2	3	3	3	3
AVG	2.8	2.6	3	3	2	1.8	1.4	1	2.2	1.6	2.4	2.2	2.6	2.6

  
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**Course Objectives**

1. To understand the concept of mechanism, degree of freedom, simple mechanisms and its inversions
2. To learn about gears, its terminology and gear trains
3. To get practice of cam profile drawing with respect to follower displacement
4. To acquire knowledge about the effect of friction in moving components
5. To provide knowledge about balancing of rotating and reciprocating masses

**UNIT I INTRODUCTION TO MECHANISMS (12)**

Simple Mechanism – Difference Between Mechanism, Machine and Structure - Types of pair – Types of Joints - Degree of Freedom – Kutzbach Criterion – Grubler's Criterion – Inversions – Four Bar Chain – Single Slider Mechanism – Double Slider Mechanism – Velocity and Acceleration of simple mechanism.

**UNIT II GEARS AND GEAR TRAINS (12)**

Classification of Gears – Gear Terminology – Law of Gearing - Length of Path of Contact – Length of Arc of Contact – Interference in Involute Gears - Minimum Number of Teeth on the Pinion in Order to Avoid Interference – Gear Trains – Simple, Compound, Reverted and Epicyclic Gear Trains.

**UNIT III CAM AND FOLLOWER (12)**

Application of Cam – Types of Cam - Classification of Follower – Terminology of Cam – Displacement Diagram and Cam Profile Drawing – Uniform Velocity – Simple Harmonic Motion – Uniform Acceleration and Retardation – Cycloidal Motion.

**UNIT IV FRICTION (12)**

Types of Friction – Screw Friction - Friction on Bearings – Friction in Clutches, Belt Drives and Rope Drives

**UNIT V BALANCING (12)**

Static and Dynamic Balancing - Balancing of several masses in same plane – different Planes, Balancing of Reciprocating Masses – Swaying Couple – Hammer Blow, Balancing of multi cylinder inline engine, Radial Engine and V Engine

**TOTAL: 60 PERIODS****Course Outcomes**

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

- CO1: Understand the concept of mechanism and its inversions, able to find degree of freedom of simple mechanisms
- CO2: Know gears and gear train applications
- CO3: Draw cam profile drawing for different types of follower motions
- CO4: Analyze and to solve the friction causing in the machine members
- CO5: Apply the knowledge of balancing concepts in designing the rotating and reciprocating machine components

**Text Books**

- T1 R.S.Khurmi & J.K.Gupta., Theory of Machines. S.Chand & Co.Ltd., New Delhi Reprint 2015.
- T2 Bansal R.K., "Theory of Machines", Laxmi Publications Pvt Ltd., New Delhi, 20th edition 2009.

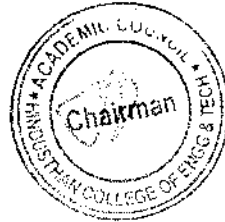
**References**

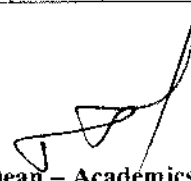
- R1 S.S.Ratan, "Theory of Machines" Tata McGrawhill,4th Edition,2014
- R2 Shigley J.E.,Pennock G.R and Uicker J.J.,Theory of Machines and Mechanisms, Oxford University Press,4th Edition,2014

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	3	2	-	-	-	-	-	3	3	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	2
CO3	3	3	3	3	3	3	-	-	-	-	-	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	2	3
CO5	3	3	3	3	3	3	-	-	-	-	-	3	2	3
AVG	3	3	3	3	3	2.67	-	-	-	-	-	2.8	2.6	2.4

  
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**Course Objectives**

- To Understand the Properties of Fluid Pressure and its Measurement.
- To learn about boundary layer concepts and flow through pipes.
- To learn about selection of hydraulic machinery for relevant applications.
- To learn about various hydraulic systems.
- To gain knowledge about various pneumatic systems.

**UNIT I FLUID PROPERTIES AND FLUID PRESSURE MEASUREMENT**

(9)

Units and dimensions- Properties of fluids-Flow characteristics – concept of control volume – application of continuity equation, energy equation and momentum equation- Fluid pressure – Pascal’s law – Definitions of absolute, gauge-atmospheric and vacuum pressures-Pressure measurement(Theory only).

**UNIT II FLOW THROUGH CIRCULAR CONDUITS**

(9)

Hydraulic and energy gradient –Boundary layer concepts –types of boundary layer thickness – Darcy Weisbach equation – friction factor- Moody diagram- commercial pipes- minor losses –Flow through pipes in series and parallel.

**UNIT III HYDRAULIC MACHINES (Theory Only)**

(9)

Hydraulic turbines –Classification – Construction and working principle – Pumps Classification – Construction and working principle of Centrifugal pumps –priming-multistage centrifugal pump. Reciprocating pump, Submersible Pump –Construction and working.

**UNIT IV HYDRAULIC SYSTEM**

(9)

hydraulic systems-layout of oil hydraulic systems-components-advantages-pumps- vane pump, gear pump, screw pump- valves-working and symbols of pressure control valve- pressure relief valves, directional control valves--3/2,5/2 valves- Sequence Valves -Cylinders-Single acting, Double acting-Hydraulic motors-Accumulators-Types

**UNIT V PNEUMATIC SYSTEM**

(9)

Pneumatic system –Layout –Components –Advantages –Compressors –Types –Construction and working –FRL unit-Control valves –flow control valves, pressure regulating valves, directional control valves –Actuators-Cylinders-Single acting, Double acting-Pneumatic motors –pneumatic Symbols-ports and positions

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Analyze the application of mass, momentum and energy equation in fluid flow.  
 CO2: Compare flow rates, pressure changes, minor and major head losses for viscous flows through pipes.  
 CO3: Evaluate the performance and operation of hydraulic turbines and pumps  
 CO4: Apply knowledge and select, operate and maintain various hydraulic systems  
 CO5: Understand various pneumatic systems for automation applications in suitable manufacturing system

**Text Books**

- T1 R.K.Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publication, 9<sup>th</sup> Edition, 2015.  
 T2 R.S.Khurmi, "Fluid Mechanics and Machinery", S.Chand and Company, Reprint, 2015  
 T3 Shanmugasundaram.K. "Hydraulic and Pneumatic controls". S.Chand & Co. 2010.

**References**

- R1 Ramamritham S "Hydraulic Fluid Mechanics and Fluid Machines" Dhanpat Rai & Sons, Delhi, Reprint, 2015  
 R2 K. S. Sundaram "Pneumatic and Pneumatic Controls". S. Chand and Company, Reprint, 2015

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2	-	2	1	-	-	1	-	3	1	2
CO2	3	3	3	2	-	2	1	-	-	1	-	3	1	2
CO3	3	3	3	2	-	2	1	-	-	1	-	3	1	2
CO4	3	3	3	2	-	2	1	-	-	1	-	3	1	2
CO5	3	3	3	2	-	2	1	-	-	1	-	3	1	2
AVG	3	3	3	2	-	2	1	-	-	1	-	3	1	2

  
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**Course Objectives**

1. To Understand the mechanisms of heat transfer under steady and transient conditions.
2. To understand the concepts of heat transfer through extended surfaces.
3. To learn the thermal analysis and sizing of heat exchangers.
4. To understand the concepts of Radiation heat transfer.
5. To understand the basic concepts of Refrigeration and Air-conditioning.

(Use of standard Heat and Mass Transfer data book, Refrigeration table and psychrometric chart is permitted)

**UNIT 01 CONDUCTION HEAT TRANSFER****(12)**

General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation –Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis –Semi Infinite and Infinite Solids –Use of Heisler’s charts.  
*Determine the Heat transfer coefficient in composite walls.*

**UNIT 02 CONVECTION HEAT TRANSFER****(12)**

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes.  
*Determination of heat transfer coefficient under natural convection from a vertical cylinder.*  
*Determination of heat transfer coefficient under forced convection from a tube.*

**UNIT 03 BOILING, CONDENSATION AND HEAT EXCHANGERS****(12)**

Nusselt’s theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis –LMTD method - NTU method. *Determine the Effectiveness of Parallel and counter-flow heat exchanger.*

**UNIT 04 RADIATION HEAT TRANSFER****(12)**

Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.  
*Determination of emissivity of a grey surface.*

**UNIT 05 REFRIGERATION AND AIR – CONDITIONING****(12)**

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, working principle of air cycle, vapour absorption system, and thermoelectric refrigeration. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations.  
*Determination of COP of a refrigeration system.*

**TOTAL: 60 PERIODS****Course Outcomes**

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

- CO1: Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
- CO2: Apply free and forced convective heat transfer correlations to internal and external flows through various surface configurations and solve problems
- CO3: Apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems
- CO4: Explain basic laws for Radiation and apply these principles to radiation heat transfer between different types of surfaces to solve problems
- CO5: Solve problems using refrigerant table / charts and psychrometric charts.

**Text Books**

- T1 Nag P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, Third Edition, Reprint, 2011.

T2 Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015.

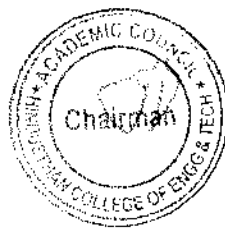
**References**

- R1 Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 8th Edition, 2010.
- R2 Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 4th Edition, Reprint, 2015.
- R3 Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 10th Edition, 2011.
- R4 R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 5th Edition, Reprint, 2018.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2	-	3	2	-	-	-	-	3	1	2
CO2	3	3	3	2	-	3	2	-	-	-	-	3	1	2
CO3	3	3	3	2	-	3	2	-	-	-	-	3	1	2
CO4	3	3	3	2	-	3	2	-	-	-	-	3	1	2
CO5	3	3	3	2	-	3	2	-	-	-	-	3	1	2
AVG	3	3	3	2	-	3	2	-	-	-	-	3	1	2

  
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**AUTO - HICET**



  
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**Course Objectives**

1. To do testing and maintenance of batteries, starting motors and generators
2. To perform testing of regulators and cut-outs relays.
3. To diagnose of ignition system faults.
4. To study the automobile electrical wiring system.
5. To gain a wide knowledge in the basic electronic components and circuits.

**SL.NO LIST OF EXPERIMENTS****a. Electrical Laboratory**

1. Testing of batteries and battery maintenance
2. Testing of starting motors and generators
3. Testing of regulators and cut – outs
4. Diagnosis of ignition system faults
5. Study of Automobile electrical wiring

**b. Electronics Laboratory**


6. Interfacing of analog sensors like Resistance Temperature Detector (RTD)
7. Interfacing of analog sensors like Linear Variable Differential Transformer (LVDT)
8. Interfacing of actuators like stepper motor
9. Interfacing of actuators like Load Cell
10. Study of Analog to Digital and Digital to Analog converters
11. Study and on board diagnosis of Engine Management System
12. Study of virtual instrumentation

**TOTAL: 45 PERIODS****Course Outcomes**

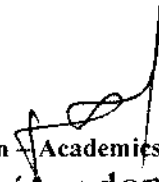
- CO1: Comprehend the working and troubleshooting of battery, regulators and cut-out relays.
- CO2: Demonstrate and diagnose the ignition system.
- CO3: Interface the sensors and actuators with microcontroller.
- CO4: Observe and troubleshoot the automotive electrical circuits and systems.
- CO5: Get exposure in the state of the art electronic technologies in testing and controlling of vehicles.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1	1	2	3	1	2	2	1	1	1	1	2	1	2
CO2	1	2	2	2	1	2	1	1	1	1	2	2	1	2
CO3	2	1	1	2	1	2	2	1	2	1	1	2	1	2
CO4	1	1	2	3	1	2	1	1	1	1	1	2	1	2
CO5	1	1	1	2	1	2	2	1	1	1	1	2	1	3
AVG	1.2	1.2	1.6	2.4	1	2	1.6	1	1.2	1	1.2	1.2	1.6	2.4

  
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**Course Objectives**

1. Acquire proficiency in utilizing an advanced modeling tool to create detailed drawings and assemblies of a piston, demonstrating precision and expertise in component modeling.
2. Develop comprehensive skills in drawing and assembly techniques for connecting rods, crankshafts, and crank webs, demonstrating precision in illustrating essential engine components.
3. Learn and apply balancing weight calculations for rotating masses and acquire drawing and assembly skills for a flywheel and ring gear teeth, demonstrating proficiency in managing rotational dynamics.
4. Develop drawing and assembly expertise through the creation of detailed illustrations for intake and exhaust manifolds, as well as inlet and exhaust valves. showcasing precision in representing crucial engine components..
5. Design and model a propeller shaft with a universal joint, demonstrating proficiency. Introduce animation and assembly principles for dynamic component understanding.

**SI.NO LIST OF EXPERIMENTS**

1. Modeling practice on advanced modeling tool
2. Drawing and assembly of piston and its components
3. Drawing and assembly of Connecting rod
4. Drawing of crank shafts and crank webs
5. Balancing weight calculations for rotating masses
6. Drawing of flywheel and ring gear teeth assembly
7. Drawing and assembly of intake and exhaust manifolds
8. Drawing and assembly of inlet and exhaust valves
9. Design and modelling of propeller shaft with universal joint.
10. Introduction to animation and the assembly

**TOTAL: 45 PERIODS****Course Outcomes**

- CO1: Students will achieve proficiency in utilizing advanced modeling tools, demonstrating precision and expertise in creating detailed drawings and assemblies of pistons.
- CO2: Students will develop comprehensive drawing and assembly skills for connecting rods, crankshafts, and crank webs, showcasing precision in illustrating essential engine components.
- CO3: Students will learn and apply balancing weight calculations for rotating masses, showcasing proficiency. Additionally, they will acquire drawing and assembly skills for a flywheel and ring gear teeth, demonstrating expertise in managing rotational dynamics.
- CO4: Students will develop drawing and assembly expertise for intake and exhaust manifolds, as well as inlet and exhaust valves. They will showcase precision in representing crucial engine components.
- CO5: Students will design and model a propeller shaft with a universal joint, demonstrating proficiency in using modeling tools and will be introduced to animation and assembly principles.

**LIST OF EQUIPMENT**

S.No.	Name of the Equipment	QTY
1	Computer Nodes	30 Nos.
2	Drafting Modelling Software	30 License

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2	3	3	3	1	2	2	2	2	3	3
CO2	3	3	3	2	2	3	2	1	2	2	2	2	2	2
CO3	3	2	3	2	2	2	3	1	2	3	2	1	2	2
CO4	3	2	3	3	3	2	2	1	2	2	2	3	3	3
CO5	3	3	3	3	3	2	2	1	2	2	2	3	3	3
AVG	3	2.6	3	2.4	2.6	2.4	2.4	1	2	2.2	2	2.2	2.6	2.6

  
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22HE4071

Soft Skills and Aptitude - III

L	T	P	C
0	0	0	1

**Course Objectives:**

1. Solve Logical Reasoning questions of easy to intermediate level
2. Solve Quantitative Aptitude questions of easy to intermediate level
3. Solve Verbal Ability questions of easy to intermediate level
4. Crack mock interviews with ease

Unit	Description	Instructional Hours
I	<b>Logical Reasoning</b> Logical Connectives - Syllogisms - Venn Diagrams: Interpretation - Venn Diagrams - Solving- Critical Reasoning	6
II	<b>Quantitative Aptitude</b> Logarithm - Arithmetic Progression - Geometric Progression - Surds and Indices - Geometry - Mensuration - Heights and Distance- Coded inequalities - Quadratic Equations - Permutation, Combination: Fundamental Counting Principle, Permutation and Combination, Computation of Permutation, Circular Permutations, Computation of Combination - Probability	14
III	<b>Verbal Ability</b> Idioms and Phrasal Verbs, Collocations, Gerund and Infinitives - Reading Comprehension for placements: Types of questions, Comprehension strategies - Articles.	6
IV	<b>Recruitment Essentials</b> Cracking interviews - demonstration through a few mocks - Sample mock interviews to demonstrate how to crack the: HR interview, MR interview, Technical interview - Cracking other kinds of interviews: Skype/ Telephonic interviews, Panel interviews, Stress interviews - Resume building – workshop: A workshop to make students write an accurate resume	4
<b>Total Instructional Hours</b>		30

**Course Outcome:**

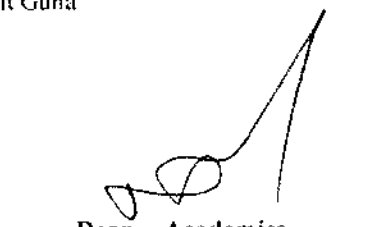
- CO1: Students will excel in the complex reasoning.  
 CO2: Students will be proficient to create and verify their own conjectures.  
 CO3: Imbibe effective relevant knowledge in English.  
 CO4: Students will identify different life skills required in personal and professional life.

**REFERENCE BOOKS:**

- R1: Logical Reasoning and Data Interpretation for CAT by Nishit K. Sinha  
 R2: A Modern Approach To Verbal Reasoning by R S Aggarwal.  
 R3: Quantitative Aptitude for Competitive Examinations (5th Edition) - Abhjit Guha  
 R4: Verbal Ability & Reading Comprehension by Ajay Singh

  
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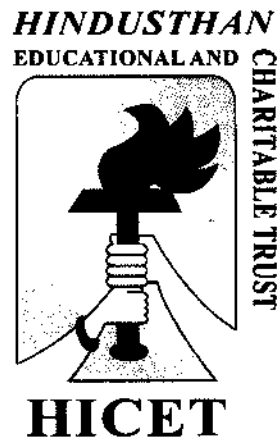


  
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**HICET**



***HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY***  
**(An Autonomous Institution Affiliated to Anna University, Chennai)**  
**(Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' Grade)**  
**Coimbatore - 641 032.**

**B.E. AUTOMOBILE ENGINEERING**



**CHOICE BASED CREDIT SYSTEM**

**Revised Curriculum and Syllabus for the EVEN Semester**  
**For the students admitted during the academic year 2022-2023**  
**Academic year 2024-25**

**2022 REGULATIONS**





**Hindusthan College of Engineering and Technology**  
(An Autonomous Institution, Affiliated to Anna University, Chennai  
Approved by AICTE, New Delhi & Accredited by NAAC with 'A++' Grade)  
Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu.



## DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

### CBCS PATTERN

### UNDERGRADUATE PROGRAMMES

### B.E. AUTOMOBILE ENGINEERING (UG)

### REGULATION-2022

(For the students admitted during the academic year 2022-2023)

### SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2.	22ME1201	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
3.	22PH1151	Physics for Non-Circuit Engineering	BSC	2	0	2	3	4	50	50	100
4.	22HE1151	English for Engineers	HSC	2	0	2	3	4	50	50	100
5.	22IT1151	Python Programming and Practices	ESC	2	0	2	3	4	50	50	100
<b>EEC COURSES (SE/AE)</b>											
6.	22HE1071	UHV	AEC	2	0	0	0	3	40	60	100
7.	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSE</b>											
8.	22MC1091/ 22MC1092	தமிழரும் தொழில் ரூட்பமும் / Indian Constitution	MC	2	0	0	1	2	0	0	0
<b>TOTAL</b>				<b>15</b>	<b>5</b>	<b>6</b>	<b>18</b>	<b>27</b>	<b>370</b>	<b>330</b>	<b>700</b>

**SEMESTER II**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA2101	Differential equations and complex analysis	BSC	3	1	0	4	4	40	60	100
2.	22CY2101	Environmental Studies	ESC	2	0	0	2	3	40	60	100
3.	22PH2101	Basics of Material Science	BSC	2	0	0	2	3	40	60	100
4.	22ME2101	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5.	22CY2152	Applied Chemistry	BSC	2	0	2	3	4	50	50	100
6.	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
7.	22ME2001	Engineering Practices	ESC	0	0	4	2	2	50	50	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE2071	Design Thinking	AEC	2	0	0	2	2	100	0	100
9.	22HE2072	Soft Skills - I	AEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSE</b>											
10.	22MC2091/ 22MC2092	தமிழர் மரபு / Heritage of Tamils	MC	2	0	0	1	2	100	0	100
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
<b>TOTAL</b>				<b>19</b>	<b>1</b>	<b>08</b>	<b>23</b>	<b>28</b>	<b>610</b>	<b>390</b>	<b>1000</b>

**SEMESTER III**

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22MA3104	Fourier analysis and numerical techniques	BSC	3	1	0	4	4	40	60	100
2.	22AU3201	Fundamentals of Automotive Engines	PCC	3	0	0	3	3	40	60	100
3.	22AU3202	Fundamentals of Thermodynamics	PCC	3	1	0	4	3	40	60	100
4.	22AU3203	Mechanics of Materials	PCC	3	1	0	4	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
5.	22AU3251	Manufacturing Technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
6.	22AU3001	Automotive Components Lab	ESC	0	0	4	2	4	60	40	100

7.	22AU3002	Mechanics of Materials Lab	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE3071	Soft Skills -2	SEC	1	0	0	1	1	100	0	100
9.	22AU3072	Machine Drawing	AEC	0	0	4	2	2	60	40	100
10.	22MC3092	Essence of Indian Traditional Knowledge	AEC	2	0	0	0	0	-	-	-
<b>TOTAL</b>				<b>17</b>	<b>3</b>	<b>14</b>	<b>25</b>	<b>29</b>	<b>490</b>	<b>410</b>	<b>900</b>

#### SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2.	22AU4201	Automotive Chassis components Design	PCC	3	0	0	3	4	40	60	100
3.	22AU4202	Automotive Electricals and Electronics systems	PCC	3	0	0	3	3	40	60	100
4.	22AU4203	Mechanics of Machines	PCC	3	1	0	4	4	40	60	100
5.	22AU4204	Fluid Mechanics and Actuating Systems	PCC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU4251	Fundamentals of Heat Transfer	PCC	3	0	2	4	4	50	50	100
<b>PRACTICAL</b>											
7.	22AU4001	Automotive Electricals and Electronics Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU4002	Computer Aided Engine components design Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE4071	Soft Skills -III	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>1</b>	<b>10</b>	<b>24</b>	<b>29</b>	<b>470</b>	<b>430</b>	<b>900</b>

\* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same will be evaluated in Semester IV.

If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed with Internship II (Total: 4 weeks-2 credits)

#### SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU5201	Vehicle design and data characteristics	PCC	3	0	0	3	4	40	60	100
2.	22AU5202	Automotive Fuels and Lubricants	PCC	3	0	0	3	3	40	60	100

3.	22AU53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	22AU53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	22AU53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
6.	22AU5251	Two and Three-wheeler technology	PCC	2	0	2	3	4	50	50	100
<b>PRACTICAL</b>											
7.	22AU5001	Automotive Fuels and Lubricants Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8.	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>6</b>	<b>21</b>	<b>25</b>	<b>410</b>	<b>390</b>	<b>800</b>

### SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU6201	Vehicle Dynamics	PCC	3	0	0	3	3	40	60	100
2.	22AU6202	Automotive Emission and Pollution Control	PCC	3	0	0	3	3	40	60	100
3.	22HE6101	Professional Ethics	HSC	3	0	0	3	3	40	60	100
4.	22AU63XX	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
5.	22AU63XX	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
6.	22XX64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
7.	22AU6001	Computer Aided Engineering Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AU6002	Engine Performance and Emission testing laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
9.	22HE6071	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
<b>TOTAL</b>				<b>20</b>	<b>0</b>	<b>8</b>	<b>24</b>	<b>28</b>	<b>460</b>	<b>440</b>	<b>900</b>

### SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1.	22AU7201	Design of Automotive Transmission systems	PCC	3	0	0	3	3	40	60	100

2.	22AU7202	Engine and Vehicle Management systems	PCC	3	1	0	4	4	40	60	100
3.	22AU7203	Hybrid and Electric Vehicle Technology	PCC	3	0	0	3	3	40	60	100
4.	22AU73XX	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
5.	22XX7401	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
<b>PRACTICAL</b>											
6.	22AU7001	Vehicle Maintenance Laboratory	PCC	0	0	4	2	4	60	40	100
<b>EEC COURSES (SE/AE)</b>											
7.	22AU7701	Internship - II*	SEC	-	-	-	2	1	100	0	100
<b>TOTAL</b>				<b>15</b>	<b>1</b>	<b>4</b>	<b>20</b>	<b>21</b>	<b>360</b>	<b>340</b>	<b>700</b>

\* - Two weeks internship carries 1 credit and it will be done during Semester VI summer vacation/placement training and same will be evaluated in Semester VII.

### SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>EEC COURSES (SE/AE)</b>											
1.	22AU8901	Project Work/Granted Patent	SEC9	0	0	20	10	20	100	100	200
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>	<b>20</b>	<b>100</b>	<b>100</b>	<b>200</b>

**Note:**

7. \*As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
8. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
9. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22.

### SEMESTER-WISE CREDIT DISTRIBUTION

<b>B.E. / B.TECH. PROGRAMMES</b>										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	-	-	-	-	-	20
3	ESC	6	7	2	-	-	-	-	-	15

4	PCC	-	-	16	21	11	10	12	-	70
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	3	3	-	6
7	EEC	1	3	3	1	1	2	2	10	23
8	MCC	1	1	-	-	-	-	-	-	2
<b>Total</b>		<b>18</b>	<b>23</b>	<b>25</b>	<b>24</b>	<b>21</b>	<b>24</b>	<b>20</b>	<b>10</b>	<b>165</b>

### OPEN ELECTIVE 1 (EMERGING TECHNOLOGIES)

Students must choose an open elective course from the given list. The content of the course should not be related to their current program of study.

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6401	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3
2	22CS6401	Block chain Technology Fundamentals	OEC	3	0	0	3	3
3	22EC6402	IoT Concepts and Applications	OEC	3	0	0	3	3
4	22IT6401	Data Science and Analytics Fundamentals	OEC	3	0	0	3	3
5	22BM6401	3D printing	OEC	3	0	0	3	3
6	22AE6401	Space Science	OEC	3	0	0	3	3
7	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
8	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
9	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
10	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
11	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
12	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
13	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
14	22AU6401	Basics of Automobile Engineering	OEC	3	0	0	3	3
15	22EE6401	Fundamentals of Electric vehicles	OEC	3	0	0	3	3
16	22FT6401	Traditional Foods	OEC	3	0	0	3	3
17	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
18	22CH6401	Waste to Energy conversion	OEC	3	0	0	3	3
19	22LS7407	NCC Level - I	OEC	3	0	0	3	3

**OPEN ELECTIVE II**

**LIFE SKILL COURSES**

Students shall choose any one of the Life Skill courses from the open elective courses listed below.

S. NO.	COURSE CODE	COURSE TITLE	CATEG ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3
8	22LS7408	Cybercrime and Awareness	OEC	3	0	0	3	3
9	22LS7409	First Aid and Emergency care	OEC	3	0	0	3	3
10	22LS7410	Business Communication	OEC	3	0	0	3	3

**PROFESSIONAL ELECTIVE COURSES: VERTICALS**

Vertical 1 Modern Mobility Systems	Vertical 2 Product and Process Development	Vertical 3 Robotics and Automation	Vertical 4 Digital and Green Manufacturing	Vertical 5 Clean and Green Energy Technologies	Vertical 6 Core Elective
22AU5301 Automotive Materials, Design and Testing	22AU5304 Value Engineering	22AU5307 Sensors and Instrumentation	22AU5310 Digital Manufacturing and IoT	22AU5313 Bioenergy Conversion Technologies	22AU5316 Automotive Chassis
22AU5302 Futuristic Vehicle Technology	22AU5305 Additive Manufacturing	22AU5308 Electrical Drives and Actuators	22AU5311 Lean Manufacturing	22AU5314 Solar Thermal Technology	22AU5317 Automotive Transmission

<b>22AU5303</b> Renewable Energy and Emission Control Technology for Off Road Vehicles	<b>22AU5306</b> CAD/CAM	<b>22AU5309</b> Embedded Systems and Programming	<b>22AU5312</b> Modern Robotics	<b>22AU5315</b> Energy Conservation in Industries	<b>22AU5318</b> Alternate Fuels and Energy Systems
<b>22AU6301</b> Vehicle Health Monitoring, Maintenance and Safety	<b>22AU6303</b> Ergonomics in Design	<b>22AU6305</b> Robotics	<b>22AU6307</b> Green Manufacturing Design and Practices	<b>22AU6309</b> Wind Energy Technology	<b>22AU6311</b> Automotive Engine Components design
<b>22AU6302</b> Autonomous and connected vehicle	<b>22AU6304</b> New Product Development	<b>22AU6306</b> Smart Mobility and Intelligent Vehicles	<b>22AU6308</b> Environment Sustainability and Impact Assessment	<b>22AU6310</b> Renewable Energy Technologies	<b>22AU6312</b> Finite Element Analysis
<b>22AU7301</b> Thermal Management of Batteries and Fuel Cells	<b>22AU7302</b> Product Life Cycle Management	<b>22AU7303</b> Haptics and Immersive Technologies	<b>22AU7304</b> Green Supply Chain Management	<b>22AU7305</b> Equipment for Pollution Control	<b>22AU7306</b> Principles of Management

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

### PROFESSIONAL ELECTIVE COURSES: VERTICALS

#### Details of Vertical I: MODERN MOBILITY SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5301	Automotive Materials, Design and Testing	PEC	3	0	0	3	3
2	22AU5302	Futuristic Vehicle Technology	PEC	3	0	0	3	3
3	22AU5303	Renewable Energy and Emission Control Technology for Off Road Vehicles	PEC	3	0	0	3	3
4	22AU6301	Vehicle Health Monitoring, Maintenance and Safety	PEC	3	0	0	3	3
5	22AU6302	Autonomous and connected Vehicle	PEC	3	0	0	3	3
6	22AU7301	Thermal Management of Batteries and Fuel Cells	PEC	3	0	0	3	3

**Details of Vertical II: PRODUCT AND PROCESS DEVELOPMENT**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5304	Value Engineering	PEC	3	0	0	3	3
2	22AU5305	Additive Manufacturing	PEC	3	0	0	3	3
3	22AU5306	CAD/CAM	PEC	3	0	0	3	3
4	22AU6303	Ergonomics in Design	PEC	3	0	0	3	3
5	22AU6304	New Product Development	PEC	3	0	0	3	3
6	22AU7302	Product Life Cycle Management	PEC	3	0	0	3	3

**Details of Vertical III: ROBOTICS AND AUTOMATION**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5307	Sensors and Instrumentation	PEC	3	0	0	3	3
2	22AU5308	Electrical Drives and Actuators	PEC	3	0	0	3	3
3	22AU5309	Embedded Systems and Programming	PEC	3	0	0	3	3
4	22AU6305	Robotics	PEC	3	0	0	3	3
5	22AU6306	Smart Mobility and Intelligent Vehicles	PEC	3	0	0	3	3
6	22AU7303	Haptics and Immersive Technologies	PEC	3	0	0	3	3

**Details of Vertical IV: DIGITAL AND GREEN MANUFACTURING**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5310	Digital Manufacturing and IoT	PEC	3	0	0	3	3
2	22AU5311	Lean Manufacturing	PEC	3	0	0	3	3
3	22AU5312	Modern Robotics	PEC	3	0	0	3	3
4	22AU6307	Green Manufacturing Design and Practices	PEC	3	0	0	3	3
5	22AU6308	Environment Sustainability and Impact Assessment	PEC	3	0	0	3	3
6	22AU7304	Green Supply Chain Management	PEC	3	0	0	3	3

**Details of Vertical V: CLEAN AND GREEN ENERGY TECHNOLOGIES**

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5313	Bioenergy Conversion Technologies	PEC	3	0	0	3	3
2	22AU5314	Solar Thermal Technology	PEC	3	0	0	3	3
3	22AU5315	Energy Conservation in Industries	PEC	3	0	0	3	3
4	22AU6309	Wind Energy Technology	PEC	3	0	0	3	3
5	22AU6310	Renewable Energy Technologies	PEC	3	0	0	3	3
6	22AU7305	Equipment for Pollution Control	PEC	3	0	0	3	3

**Details of Vertical VI: CORE ELECTIVE**

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AU5316	Automotive Chassis	PEC	3	0	0	3	3
2	22AU5317	Automotive Transmission	PEC	3	0	0	3	3
3	22AU5318	Alternate Fuels and Energy Systems	PEC	3	0	0	3	3
4	22AU6311	Automotive Engine Components design	PEC	3	0	0	3	3
5	22AU6312	Finite Element Analysis	PEC	3	0	0	3	3
6	22AU7306	Principles of Management	PEC	3	0	0	3	3

**Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

**Clause 4.10** of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

## VERTICALS FOR MINOR DEGREE

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

Note: Each programme should provide verticals for minor degree

Minor Degree - Automotive Vehicle Technology (Offered by Automobile Engineering )									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5471	Automotive Engines	3	0	0	3	40	60	100
2	22AU6471	Automotive Chassis	3	0	0	3	40	60	100
3	22AU6472	Automotive Transmission	3	0	0	3	40	60	100
4	22AU7471	Automotive Electronics	3	0	0	3	40	60	100
5	22AU7472	Intelligent vehicular systems	3	0	0	3	40	60	100
6	22AU8471	Electric and Hybrid vehicles	3	0	0	3	40	60	100

Minor Degree - Fintech and Block Chain (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CS5601	Financial Management	3	0	0	3	40	60	100
2	22CS5602	Fundamentals of Investment	3	0	0	3	40	60	100
3	22CS5603	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	22CS5604	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	22CS5605	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	22CS5606	Introduction to Fintech	3	0	0	3	40	60	100

Minor Degree - Entrepreneurship (common to all departments)									
S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22BA5601	Foundation of Entrepreneurship	3	0	0	3	40	60	100
2	22BA6601	Introduction to Business Venture	3	0	0	3	40	60	100
3	22BA6602	Team Building & Leadership Management for Business	3	0	0	3	40	60	100

4	22BA7601	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100
5	22BA7602	Principles of Marketing Management for Business	3	0	0	3	40	60	100
6	22BA8601	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100

**Minor Degree - Environment and Sustainability (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22CEXXXX	Sustainable infrastructure Development	3	0	0	3	40	60	100
2	22CEXXXX	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
3	22CEXXXX	Sustainable Bio Materials	3	0	0	3	40	60	100
4	22CEXXXX	Materials for Energy Sustainability	3	0	0	3	40	60	100
5	22CEXXXX	Green Technology	3	0	0	3	40	60	100
6	22CEXXXX	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100

**Honors Degree - Electric and hybrid vehicle development**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5371	Fundamentals of Electric and Hybrid Vehicles	3	0	0	3	40	60	100
2	22AU6371	Battery Technology	3	0	0	3	40	60	100
3	22AU6372	Automotive Embedded Systems	3	0	0	3	40	60	100
4	22AU7371	Advanced Automotive Safety Systems	3	0	0	3	40	60	100
5	22AU7372	Special Purpose Electric Vehicle	3	0	0	3	40	60	100
6	22AU8371	Energy Storage Techniques for Electric Vehicle	3	0	0	3	40	60	100

**Honors Degree - Motorsport Engineering**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5372	Composite Structure	3	0	0	3	40	60	100
2	22AU6373	High performance engine design	3	0	0	3	40	60	100
3	22AU6374	Motorsports Electric Vehicle	3	0	0	3	40	60	100
4	22AU7373	Motorsports Vehicle Body Engineering	3	0	0	3	40	60	100
5	22AU7374	Motorsports Race Electronics and Control Systems	3	0	0	3	40	60	100
6	22AU8372	Motorsports racing circuits and Design	3	0	0	3	40	60	100

**Honors Degree - Vehicle Development and Validation**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	22AU5373	Automotive Product Design and Development	3	0	0	3	40	60	100
2	22AU6375	Noise, Vibration and Harshness	3	0	0	3	40	60	100
3	22AU6376	Automotive Instrumentation	3	0	0	3	40	60	100
4	22AU7375	Testing and Measurement Systems	3	0	0	3	40	60	100
5	22AU7377	Homologation	3	0	0	3	40	60	100
6	22AU8373	Automotive Prototyping	3	0	0	3	40	60	100

**CREDIT DISTRIBUTION**

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	23	22	24	20	10	165

\* Student can earn extra credit 35 over and above the total credits

**List of NPTEL Course**

S.NO	Course ID	Course Name	Institute
1	noc25-bt28	Material and Energy Balances	IIT Madras
2	noc25-ce04	Air Pollution and Control	IIT Roorkee
3	noc25-ce21	Finite Element Method	IIT Kharagpur
4	noc25-ch29	Matlab Programming for Numerical Computation	IIT Madras
5	noc25-ch40	Renewable Energy Engineering: Solar, Wind And Biomass Energy Systems	IIT Guwahati
6	noc25-cs44	Introduction To Internet Of Things	IIT Kharagpur
7	noc25-cs46	Introduction to Machine Learning	IIT Madras
8	noc25-de02	Fundamentals of Automotive Systems	IIT Madras
9	noc25-de04	Strategies for Sustainable Design	IIT Hyderabad
10	noc25-ee16	Deep Learning	IIT Kharagpur

11	noc25-ee33	EV - Vehicle Dynamics and Electric Motor Drives	IIT Delhi
12	noc25-ee76	Sensors and Actuators	IISc Bangalore
13	noc25-me15	Design of Mechanical Transmission Systems	IIT Madras
14	noc25-me17	Dynamics and Control of Mechanical Systems	IISc Bangalore
15	noc25-me19	Engine system and performance	IIT Guwahati
16	noc25-me29	Fundamentals of Combustion	IIT Madras
17	noc25-me62	Power Plant System Engineering	IIT Guwahati
18	noc25-mg52	Principles of Management	IIT Roorkee
19	noc25-mm06	Clean Coal Technology	IIT-ISM Dhanbad
20	noc25-mm21	Mechanical Behaviour of Materials (Part - I)	IIT Kanpur

**ADDITIONAL CREDIT COURSE FOR NCC CADETS**

S.No	Course code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1	22HE1074	NCC General and National Integration	VA	1	0	0	1	100	0	100
2	22HE2074	Social Services and Community Development	VA	1	0	0	1	100	0	100
3	22HE3074	Leadership Qualities and Camp Activities	VA	1	0	0	1	100	0	100
4	22HE4074	General awareness, communication and Aero engines	VA	1	0	0	1	100	0	100

**ADDITIONAL CREDIT COURSE FOR AUTOMOBILE ENGINEERING**

S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1	22VAAU01	Foundry Technology	VA	30 hrs	Internal	1
2	22VAAU02	Forming and Shaping of Plastics	VA	30 hrs	Internal	1
3	22VAAU03	Microcontroller Programming in Automotive applications	VA	30 hrs	Internal	1
4	22VAAU04	Vehicle development and testing regulations (ARAI)	VA	30 hrs	Internal	1
5	22VAAU05	Bigdata Analysis	VA	30 hrs	Internal	1

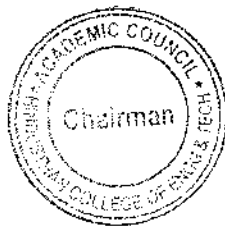
6	22VAAU06	Data mining	VA	30 hrs	Internal	1
7	22VAAU07	Fire and safety Engineering	VA	30 hrs	Internal	1
8	22VAAU08	Introduction to MS office	VA	30 hrs	Internal	1
9	22VAAU09	Advanced Automotive Electrical and Electronics	VA	30 hrs	Internal	1
10	22VAAU10	Autodesk Fusion 360	VA	30 hrs	Internal	1

**Note: Non Credit Course results will not consider for Award of Degree**

*[Signature]*  
 Chairman, Board of Studies  
**Chairman - BoS**  
**AUTO - HiCET**

*[Signature]*  
 Dean - Academics  
**Dean (Academics)**  
**HiCET**

Principal





**Course Objectives**

1. To acquire the knowledge about the vibration and responses.
2. To Learn the importance of tire and its dynamics.
3. To Learn the ride properties of the vehicle.
4. To obtain knowledge on the longitudinal vibration and their control.
5. To Learn the Handling techniques of the vehicles.

**UNIT I VIBRATIONS**

(9)

Definitions - Sources of Vibration - Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, - Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility ratio, Vibration absorber, Vibration measuring instruments, Critical speed.

**UNIT II TIRES**

(9)

Tyre axis system - Forces and Moments on tyre - tyre marking and structure. Hydroplaning - Rolling resistance, factors affecting rolling resistance. Longitudinal and Lateral force at various slip angles. Tractive and cornering property of tyre. Performance of tyre on wet surface. Ride property of tyres. Various test carried on a tyre.

**UNIT III RIDE AND CONTROL**

(9)

Suspension requirements - types. Passive, semi active and Active suspension using Quarter car, half car and full car vibrating model. - Control systems - Vehicle Response Properties - Air suspension system.

**UNIT IV LONGITUDINAL DYNAMICS AND CONTROL**

(9)

Load distribution of three and four wheeled vehicle. Calculation of maximum acceleration, tractive effort, and reaction forces for different drive vehicles. Power limited acceleration and traction limited acceleration. Braking and Driving torque. ABS Braking system.

**UNIT V HANDLING AND CONTROL**

(9)

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

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Develop physical and mathematical models to predict the dynamic response of vehicles.
- CO2: Recognize the proper tires for better performance of vehicle on all the road surfaces
- CO3: Summarize the dynamic analyses in the design of vehicles.
- CO4: Evaluate the longitudinal dynamics and control in an automobile.
- CO5: Explain the handling and control of lateral vibrations of the vehicle.

**Text Books**

- T1 Rajesh Rajamani. "Vehicle Dynamics and Control". 1st edition, Springer. 2005
- T2 Wong, J. Y.. "Theory of Ground Vehicles", 3rd Edition, Wiley-Interscience. 2008
- T3 Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics". Society of Automotive Engineers Inc. 2014

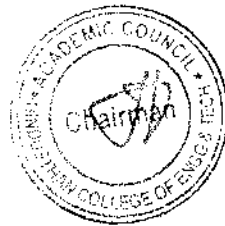
**References**


- R1 Singiresu S. Rao, "Mechanical Vibrations", 5th Edition, Prentice Hall. 2010
- R2 Hans B Pacejka. "Tire and Vehicle Dynamics", 2nd edition. SAE International, 2005
- R3 Dean Kamopp. "Vehicle Dynamics. Stability. and Control", Second Edition. CRC Press. 2013

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	1	1	-	-	-	-	-	-	1	1	2
CO2	3	3	2	1	1	1	1	-	-	-	-	1	1	1
CO3	2	3	3	3	1	-	-	-	-	-	-	-	1	-
CO4	3	3	2	3	2	2	-	-	-	-	-	-	1	2
CO5	3	3	2	1	1	1	-	-	-	-	-	-	1	1
AVG	2.8	3	2.2	1.6	1.2	1.3	1	-	-	-	-	1	1	1.5

  
 Chairman, Board of Studies  
**Chairman - BoS**  
**AUTO - HICET**



  
 Dean - Academics  
**Dean (Academics)**  
**HICET**

22AU6202

**AUTOMOTIVE EMISSION AND POLLUTION CONTROL**

L	T	P	C
3	0	0	3

**Course Objectives**

1. To create an awareness on the various environmental pollution and Noise pollution aspects and issues.
2. To analyze the formation of major pollutants like CO, NO<sub>x</sub> in SI Engine.
3. To design various control techniques to reduce pollutants in CI Engine combustion.
4. To impart knowledge on various emission instruments and techniques.
5. To determine the various after treatment process in BSVI Engine technology to minimize emissions with Flexi fuel.

**UNIT I SOURCES OF POLLUTION AND NOISE****(9)**

Sources of Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment human beings. Emission control techniques – Emission standards-Euro norms- BS VI Standards-OBD I and OBD II. Sources of Noise — Engine Noise, Transmission Noise, vehicle structural noise, aerodynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction — Silencer Design.

**UNIT II EMISSION FROM SI AND CI ENGINE AND ITS CONTROL****(9)**

Emission formation in SI Engines- Carbon monoxide- Unburned hydrocarbon, NO<sub>x</sub>, Smoke — Effects of design and operating variables on emission formation – controlling of pollutants –Catalytic converters — Charcoal Canister — Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion.

**UNIT III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL****(9)**

Formation of White, Blue, and Black Smokes, NO<sub>x</sub>, soot, sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of Operating variables on Emission formation — Fumigation, EGR, HCCI, Particulate Traps, SCR — Cetane number Effect.

**UNIT IV TEST PROCEDURE, INSTRUMENTATION & EMISSION MEASUREMENT****(9)**

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

**UNIT V BS6 ENGINE TECHNOLOGY AND FLEXI FUEL****(9)**

BS6 Engine Technology- Emission standard comparison of BSIV and BSVI. Emission standard -PI Engine -CI Engine-Hybrid vehicle-OBD – Stage I, stage II A and II B – Emission thresholds and Monitoring items. AdBlue – DEF – SCR – LNT – NSC. Flexi fuel – Ethanol production- E10-E25-E85 –E10- Toyota Innova Hycross.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Demonstrate the fundamentals of formation of automobile pollutions and noise in IC Engines.
- CO2: Design the control techniques for minimizing emissions in SI Engine.
- CO3: Demonstrate the fundamentals of formation of emission and control in CI Engines.
- CO4: Experiment with the various methods of test procedures and measurement in automotive engines.
- CO5: Identify the BS6 emissions standard and various fuel added to reduce the vehicular pollution.

**Text Books**

- T1 G.P.Springer and D.J.Patterson. Engine Emissions, Pollutant formation, Plenum Press. New York, 1986.
- T2 Pundir. B.P., " IC Engines Combustion and Emissions" Narosa Publishers, Second edition, 2017
- T3 D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication, 1985
- T4 Indian Emission Regulation – ARAI. Empowering sustainable mobility Transition. <https://cms.araiindia.com>

**References**

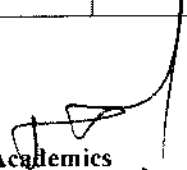
- R1 Ronald M. Heck, Robert J. Farrauto, Suresh T. Gulati, "Catalytic Air Pollution Control: Commercial Technology", 3rd Edition, April 2012, Wiley.
- R2 Ganesan, V., "Internal Combustion Engines", Tata McGraw Hill Co., 2010
- R3 J. Robert Mondt, "Cleaner Cars: The History and Technology of Emission Control", Annotation c. Book News, Inc., Portland, 2000.
- R4 L.Lberanek, "Noise Reduction", McGrawhill Company., New York 2019.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	-	1	1	-	3	3	1	-	-	1	3	2	3
CO2	3	2	1	2	-	3	3	1	-	-	2	3	2	3
CO3	3	2	1	2	-	3	3	1	-	-	2	3	2	3
CO4	3	3	2	3	-	3	3	2	-	-	3	3	2	3
CO5	3	3	2	3	-	3	3	2	-	-	3	3	2	3
AVG	3	2	1.4	2.2	-	3	3	1.4	-	-	2.2	3	2	3

  
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**PROFESSIONAL ETHICS**

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**Course Objectives**

6. To foster ethical behavior and life skills for holistic development.
7. To educate the value of Engineering Ethics
8. To inculcate the social responsibility of an engineer.
9. To impart knowledge on issues related to safety, responsibility and rights
10. To educate on professional practice on global issues

**UNIT I VALUE EDUCATION**

(9)

Moral values and Right understanding- Holistic development and the Role of Value Education- Understanding Value Education- Self-exploration as the process for value Education- Integrity -Work Ethics- Empathy- Spirituality

**UNIT II ENGINEERING ETHICS**

(9)

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION**

(9)

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS**

(9)

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

**UNIT V GLOBAL ISSUES**

(9)

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility

**TOTAL: 45 PERIODS**

**Course Outcomes**

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

- CO1: Understand the importance of various components of human values
- CO2: Apply ethics in society
- CO3: Discuss the ethical issues related to engineering and
- CO4: Realize the responsibilities and rights in the society
- CO5: Apply professional ethics in solving global issues

**Text Books**

- T1 Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata Mc Graw Hill, New Delhi, 2003.
- T2 Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi.

**References**

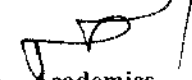
- R1 Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
- R2 John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1	1	1	1	-	3	3	3	-	1	1	3	2	3
CO2	1	2	1	2	-	3	3	3	-	1	2	3	2	3
CO3	1	2	1	2	-	3	3	3	-	1	2	3	2	3
CO4	1	3	2	3	-	3	3	3	-	1	3	3	2	3
CO5	1	3	2	3	-	3	3	3	-	1	3	3	2	3
AVG	1	2	1.4	2.2	-	3	3	3	-	1	2.2	3	2	3

  
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**Course Objectives**

1. To give exposure to software tools needed to analyze automobile field problems.
2. To expose the students to different applications of simulation and analysis tools in vehicle components.
3. To impose knowledge in the behavior our automotive components in real time.
4. To analyze the engine and its components for its thermal behavior.
5. To perform modal analysis on suspension system to Learn its work cycle.

**LIST OF EXPERIMENTS**

- 1 Force and Stress analysis on elements in vehicular frames and cross members.
- 2 Stress and deflection analysis in vehicle ladder frame with different loading conditions.
- 3 Stress analysis of vehicle shell and body components.
- 4 Stress analysis of Axis – Symmetric components like piston, etc..
- 5 Thermal stress and heat transfer analysis of firewall.
- 6 Thermal stress analysis of engine cylinder.
- 7 Vibration analysis of suspension systems.
- 8 Modal analysis of suspension springs.
- 9 Harmonic, transient and spectrum analysis of suspension systems.
- 10 Dynamic Analysis of suspension springs.

**TOTAL: 45 PERIODS****Course Outcomes**

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

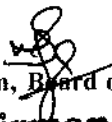
- CO1: Model and analyze experiments to meet real world system of various automotive components.  
 CO2: Perform thermal analysis for automotive engines and various parts related to it.  
 CO3: Carryout modal analysis of suspension system  
 CO4: Study the behavior of suspension system and its dynamic behavior.  
 CO5: Simulate the stress and deflection analysis of vehicular components.

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

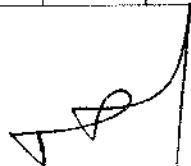
S.No.	NAME OF THE EQUIPMENT	QTY.
1	Computer Workstation	15
2	Multi Body Dynamic Software Suitable for Mechanism simulation and analysis	15 Licenses

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	3	2	1	1	-	3	-	2	-	2	3	2
CO2	3	3	2	2	1	2	-	3	-	2	-	1	3	2
CO3	3	3	2	2	1	2	-	3	-	2	-	1	3	2
CO4	3	3	2	2	1	1	-	3	-	2	-	1	3	2
CO5	3	3	2	2	2	1	-	3	-	2	-	1	3	2
AVG	3	3	2.2	2	1.2	1.4	-	3	-	2	-	1.2	3	2

  
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**Course Objectives**

1. To acquire the basic knowledge of different dynamometers, valve and port timing diagram.
2. To Conduct the Performance and emission Test on the multi cylinder CI and SI engines.
3. To conduct retardation test on IC engine.
4. To conduct heat balance and Morse test on multi cylinder petrol and diesel engines.
5. To Learn the P- $\theta$  and P-V Diagrams.

**LIST OF EXPERIMENTS**

1. Study of Hydraulic, Electrical and Eddy Current Dynamometers
2. Valve Timing and Port Timing Diagram
3. Performance and Emission Test on Two-Wheeler SI Engine
4. Performance and Emission Test on Automotive Multi-Cylinder SI Engine
5. Performance and Emission Test on Automotive Multi-Cylinder CI Engine
6. Retardation Test on I.C. Engines.
7. Heat Balance Test on Automotive Multi-Cylinder SI Engine
8. Heat Balance Test on Automotive Multi-Cylinder CI Engine
9. Morse Test on Multi-Cylinder SI Engine
10. P- $\theta$  and P-V Diagrams for IC Engine with Piezo-Electric Pick Up, Charge Amplifier, Angle Encoder and PC

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Perform tests using different dynamometers, valve and port timing diagram.
- CO2: Experiment with the Performance and emission Test on the multi cylinder CI and SI engines
- CO3: Interpret the retardation test on IC engines
- CO4: Perform heat balance and Morse test on multi cylinder petrol and diesel engines
- CO5: Plot and summarize the P- $\theta$  and P-V Diagrams.

**LIST OF EQUIPMENTS**

Sl.No.	Name of the equipment	Quantity
1.	Hydraulic Dynamometer	1 No.
2.	Eddy current dynamometer	1 No.
3.	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. Each
10.	Piezo-electric pick up, Charge Amplifier, Angle Encoder and PC	1 Set

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	3	3	2	3	3		-	1		3	3	2
CO2	3	2	3	3	2	3	3		-	1		2	2	3
CO3	3	2	3	3	2	3	2		-	1		3	3	3
CO4	3	2	3	2	2	2	2		-	1		2	2	2
CO5	3	2	3	2	1	2	2		-	1		2	3	3
AVG	3	2	3	2.6	1.8	2.6	2.4	-	-	1	-	2.4	2.6	2.6

  
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Soft Skills - V

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**Course Objectives:**

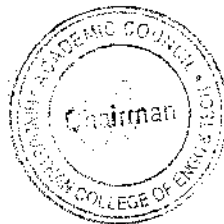
1. To make the students aware of the importance, the role and the content of softskills through instruction, knowledge acquisition, demonstration and practice.
2. To learn everything from equations to probability with a completely different approach.
3. To make the students learn on an increased ability to explain the problem comprehensively.

Unit	Description	Instructional Hours
I	<b>Group Discussion &amp; Presentation Skills:</b> GD skills – Understanding the objective and skills tested in a GD – General types of GDs – Roles in a GD – Do's & Don'ts – Mock GD & Feedback.- Presentation Skills – Stages involved in an effective presentation – selection of topic, content, aids – Engaging the audience – Time management - Team Building– Mock Presentations & Feedback	10
II	<b>Interview Skills and Personality Skills:</b> Interview handling Skills – Self preparation checklist – Grooming tips: do's & don'ts – mock interview & feedback - Leadership Skills - Interpersonal skills-creative thinking-problem solving-analytical skills	10
III	<b>Business Etiquette &amp; Ethics:</b> Etiquette – Telephone & E-mail etiquette – Dining etiquette – do's & Don'ts in a formal setting – how to impress - Crisis Management - Ethics – Importance of Ethics and Values – Choices and Dilemmas faced – Discussions from news headlines.	10
<b>Total Instruction Hours</b>		30
<b>Course Outcome:</b>	CO1: Students will have learnt to keep going according to plan, coping with the unfamiliar, managing disappointment and dealing with conflict.	
	CO2: Students will Actively participate meetings, Group Discussions/ interviews and prepare & deliver presentations	
	CO3: Students will define professional behavior and suggest standards for appearance, actions and attitude in a Business environment	

**REFERENCE BOOKS:**

- R1: Bridging the Soft Skills Gap: How to Teach the Missing Basics to Today's Young Talent- Bruce Tulgan
- R2: BPB Publications Soft Skills Personality Development For Life Success-Prashant Sharma
- R3: Soft Skills and Employability Skills by Sabina Pillai-\*

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**Course Objectives**

1. To provide knowledge about various renewable energy technologies
2. To study the solar energy measurement and designing of various solar energy utilized systems.
3. To provide knowledge about wind energy system
4. To understand the applications of energy from waste and designing of bio gas plant.
5. To gain knowledge about application of various renewable energy technologies.

**UNIT I INTRODUCTION**

(9)

Need for Maintenance – importance, classification of maintenance work -basic problem diagnosis. Maintenance of vehicle systems – power pack, tyres, safety systems. Scheduled maintenance services -service intervals – On-board diagnostics, Computerized engine analyzer study and practice- OBD and scan tools

**UNIT II MAINTENANCE OF WORKSHOP RECORDS AND SCHEDULE**

(9)

Importance of maintenance, scheduled and unscheduled maintenance, requirements of maintenance, preparation of check lists, vehicle down time, vehicle inspection, inspection schedule, maintenance of records, reports log books, trip sheets and other forms, safety precautions in maintenance, fleet maintenance requirement, work shop layout, tools and equipment, spare parts and lubricants stocking , manpower, training, workshop management, warranty, replacement policy.

**UNIT III VEHICLE SYSTEM MAINTENAN**

(9)

Clutch- adjustment and service, Maintenance and Service of Hydraulic brake, Bleeding of brakes, Checking ABS and components. Maintenance and Service of McPherson strut, coil spring. tyre wear, measurement of read depth and tyre rotation, Computerized wheel balancing & wheel alignment, Maintenance and Service of steering linkage, steering column, Rack and pinion steering

**UNIT IV MAINTENANCE OF AUXILIARY SYSTEMS**

(9)

Servicing of fuel system of different types of vehicles, maintenance of fuel system of different types of vehicle, calibration and tuning of engine for optimum fuel supply, maintenance of cooling system, water pump, radiator, thermostat, anticorrosion and antifreeze additives, maintenance of lubrication system, different grades of oil, lubricant oil additive, lubricating oil changing, greasing of part, minor and major repairs of body parts, maintenance of door locking mechanism, maintenance of window glass actuating system

**UNIT V SIMULATION OF SAFETY CONCEPT**

(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. Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system Interactions.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Attained knowledge about various renewable energy technologies.  
 CO2: Calculate the performance of solar collectors.  
 CO3: Understand the concept of various wind energy system.  
 CO4: Develop skills in bio energy.  
 CO5: Attained knowledge about various application of renewable energy technologies

**Text Books**

- T1 5th Edition, Advanced Automotive Fault Diagnosis Automotive Technology: Vehicle Maintenance and Repair By Tom Denton  
 T2 Safety Management System and Documentation Training Programme Handbook by S. V. Paul ISBN: 978812392344

**References**

- R1 Ed May, "Automotive Mechanics Volume One" and Two, Mc Graw Hill Publications, Tenth edition, 2018

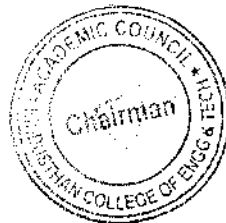
R2 Bosch Automotive Handbook, Tenth Edition, 2018


R3 Jack Erjavek, A systems approach to Automotive Technology, Cengage Learning, 5th Edition, 20

### CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	1	2	2	1	2	2	2	1	2	2	3	2	1
CO2	3	1	2	2	1	2	2	2	1	1	1	3	2	1
CO3	3	1	2	2	1	2	3	2	2	2	1	2	2	3
CO4	3	1	2	2	1	2	3	2	2	1	1	3	1	3
CO5	2	1	2	2	1	3	2	2	2	3	1	3	1	3
AVG	2.8	1	2	2	1	2.2	2.4	2	1.6	1.8	1.2	2.8	1.6	2.2

  
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**Course Objectives**

1. To understand the types of autonomous vehicle technology
2. To enumerate the path planning and decision making
3. To learn the concepts of sensors, perception and visualization.
4. To develop the networking technologies and connected vehicles.
5. To learnt the application of autonomous vehicle.

**UNIT I INTRODUCTION TO AUTONOMOUS VEHICLE TECHNOLOGY**

(9)

Introduction - SAE autonomous Level Classification-Examples-Application of Autonomous Vehicle-Advantages and Disadvantages of Autonomous Vehicles

**UNIT II PATH PLANNING AND DECISION MAKING**

(9)

Principles of decision make and path planning for autonomous vehicles-Decision making approaches-Approximation-Heuristic-Graph based-Point guidance. Verification and validation of decision making and path planning- Application examples of task allocation and path planning algorithms.

**UNIT II SENSORS, PERCEPTION AND VISUALISATION**

(9)

Introduction to sensors, perception and visualisation for autonomous vehicles-Sensor integration architectures and multiple sensor fusion-AI algorithms for sensing and imaging-neural networks

**UNIT IV NETWORKING AND CONNECTED VEHICLES**

(9)

Current and future vehicle networking technologies- CAN, LIN, MOST and Flex-ray. The use of modern validation and verification methods- software-in-the-loop, and hardware-in-the-loop techniques. The role of Functional Safety and ISO26262 within the overall control system. Inter-dependency between software engineering and control system-advanced test methods for the validation of safety-critical systems. Connected vehicle control (CACC). vehicle-to-vehicle [V2V], vehicle-to-infrastructure [V2I], and Vehicle to "Cloud" [V2C]. Applications such as intelligent traffic signals, collaborative adaptive cruise and vehicle platooning.

**UNIT V HUMAN FACTORS AND ETHICAL DECISION MAKING**

(9)

Introduction to Human Factors-Human Performance: Perception and Attention-Situation Awareness and Error-Human Reliability: Driver Workload and Fatigue-Emotion and Motivation in Design-Trust in Autonomous Vehicles and Assistive Technology-Designing ADAS Systems-Driverless Vehicles and Ethical Dilemmas: Human Factors and Decision Making Software-Application of Human Factors in Autonomous Vehicles. International and national regulatory frameworks for CAV and their safe operation.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Estimate vehicle state based on available data.
- CO2: Describe various computer vision features and techniques.
- CO3: Develop motion plan for the vehicle based on the environment, behaviour and interaction of objects.
- CO4: Describe the applications of AI in autonomous and connected vehicles.
- CO5: Enumerate the Human factors and ethical decision making of autonomous vehicle.

**Text Books**

- T1 Autonomous Driving: How the Driverless Revolution will Change the World, by Andreas Herrmann, Walter Brenner, Rupert Stadler, ISBN-10 1787148343, ISBN-13 978-1787148345, Emerald Publishing Limited, 26 March 2018
- T2 Autonomous Vehicles: Technologies, Regulations, and Societal Impacts, George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, Paperback ISBN: 9780323901376, eBook ISBN: 9780323901383, 1st Edition - April 14, 2021. Elsevier

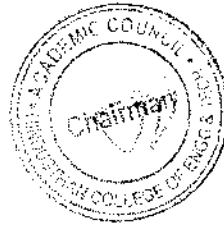
**References**

- R1 Driverless: Intelligent Cars and the Road Ahead (MIT Press) 1st Edition, by Hod Lipson . Melba Kurmanr), ISBN-13: 978-0262035224, ISBN-10: 0262035227, September 23, 2016.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	2	2	2	-	2	-	-	2	2	2	3
CO2	2	2	2	2	2	2	-	2	-	-	2	2	2	3
CO3	3	3	3	3	3	3	-	2	-	-	2	3	2	3
CO4	3	3	3	3	3	3	-	2	-	-	2	3	2	3
CO5	3	3	3	3	3	3	-	2	-	-	2	3	2	3
AVG	2.6	2.6	2.6	2.6	2.6	2.6	-	2	-	-	2	2.6	2	3

  
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**ERGONOMICS IN DESIGN**

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<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives**

1. To study the basic Ergonomics industrial Design.
2. To understand the concept of Ergonomics display and Production.
3. To understand Visual Effect of Line and Colour
4. To understand the aesthetic concepts.
5. To inculcate the knowledge required to solve Industrial Design.

**UNIT I ERGONOMICS AND INDUSTRIAL DESIGN**

(9)

Introduction: An approach to industrial design -elements of design structure for industrial design in engineering application in modern manufacturing systems. Ergonomics and Industrial Design: Introduction -general approach to the man-machine relationship- workstation design-working position.

**UNIT II ERGONOMICS AND PRODUCTION**

(9)

Shapes and sizes of various controls and displays-multiple, displays and control situations - design of major controls in automobiles, machine tools etc Ergonomics and Production: ergonomics and product design - ergonomics in automated systems- expert systems for ergonomic design. Anthropometric data and its applications in ergonomic, design- limitations of anthropometric data use of computerized database.

**UNIT III VISUAL EFFECTS OF LINE AND COLOUR**

(9)

The mechanics of seeing- psychology of seeing general influences of line and form. Colour and light -colour and objects- colour and the eye -colour consistency- colour terms- reactions to colour and colour continuation -colour on engineering equipment's.

**UNIT IV AESTHETIC CONCEPTS**

(9)

Concept of unity- concept of order with variety -concept of purpose style and environment Aesthetic expressions. Style-components of style- house style, observation style in capital goods, case study.

**UNIT V INDUSTRIAL DESIGN IN PRACTICE**

(9)

General design-specifying design equipment's- rating the importance of industrial design -industrial design in the design process.

**TOTAL: 45 PERIODS**

**Course Outcomes**

**At the end of this course students will be able to:**

- CO1: Understand the basic Ergonomics industrial Design
- CO2: Understand the concept of Ergonomics display and Production
- CO3: Apply the Visual Effect of Line and Colour
- CO4: Understand the aesthetic concepts
- CO5: Solve the knowledge required to solve Industrial Design.

**Text Books**

- T1 Industrial Design for Engineers - Mayall W.H. - London Hiffee books Ltd. -1988.
- T2 Applied Ergonomics Hand Book - Brain Shakel (Edited) - Butterworth scientific. London -1988.

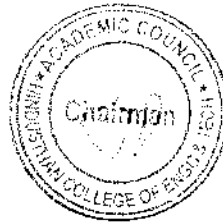
**References**

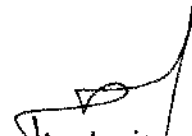
- R1 Introduction to Ergonomics - R. C. Bridger - McGraw Hill Publications - 1995.
- R2 Human Factor Engineering - Sanders & McCormick - McGraw Hill Publications – 6 th edition. 2002.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	3	3	1	-	-	-	1	2	1	3	2
CO2	2	2	2	3	2	1	-	-	1	2	3	1	3	2
CO3	2	2	3	3	3	2	-	1	1	1	3	1	3	2
CO4	3	3	3	3	3	1	-	-	1	-	3	2	3	2
CO5	2	2	2	2	1	-	-	-	-	1	2	1	2	1
AVG	2.2	2.2	2.4	2.8	2.5	1.2	-	1	1	1.2	2.6	1.2	2.8	2.4

  
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**Course Objectives**

1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2. Identifying opportunity and planning for new product design and development.
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and testing the concepts for new product design and development.
5. Applying the principles of Industrial design and prototype for new product design and development.

**UNIT I INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT (9)**

Introduction – Characteristics of Successful Product Development – People involved in Product Design and Development – Duration and Cost of Product Development – The Challenges of Product Development – The Product Development Process – Concept Development: The Front End Process – Adapting the Generic Product Development Process – Product Development Process Flows – Product Development Organizations.

**UNIT II OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING (9)**

Opportunity Identification: Definition – Types of Opportunities – Tournament Structure of Opportunity Identification – Effective Opportunity Tournaments – Opportunity Identification Process – Product Planning: Four types of Product Development Projects – The Process of Product Planning.

**UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS (9)**

Identifying Customer Needs: The Importance of Latent Needs – The Process of Identifying Customer Needs. Product Specifications: Definition – Time of Specifications Establishment – Establishing Target Specifications – Setting the Final Specifications, Customer Experience (CX) Design: Emphasis on emotional and experiential aspects of product use.

**UNIT IV CONCEPT GENERATION, SELECTION & TESTING (9)**

Concept Generation: Activity of Concept Generation – Structured Approach – Five step method of Concept Generation. Concept Selection: Methodology – Concept Screening and Concepts Scoring. Concept testing: Seven Step activities of concept testing. TRIZ (Theory of Inventive Problem Solving) and brainstorming methodologies

**UNIT V INDUSTRIAL DESIGN & PROTOTYPING (9)**

Industrial Design: Need and Impact – Industrial Design Process. Prototyping – Principles of Prototyping – Prototyping Technologies – Planning for Prototypes, Eco-friendly materials and processes, Additive manufacturing (3D printing) and digital twin technologies

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the principles of the generic product development process and organizational structures.
- CO2: Identify opportunities and plan effectively for product development.
- CO3: Conduct customer needs analysis and establish product specifications.
- CO4: Generate, evaluate, and test concepts for innovative product designs.
- CO5: Apply industrial design principles and advanced prototyping techniques.

**Text Books**

- T1 Ulrich K.T., Eppinger S. D. and Anita Goyal, "Product Design and Development" McGraw-Hill Education; 7 edition, 2020.
- T2 Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
- T3 Rosenthal S., "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN1-55623-603-4.

**References**

- R1 Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.
- R2 Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.

R3 Pugh S, "Total Design Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, 1991, ISBN0-202-41639-5

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	3	2	1	1		3		2		2	3	2
CO2	3	3	2	2	1	2		3		2		1	3	2
CO3	3	3	2	2	1	2		3		2		1	3	2
CO4	3	3	2	2	1	1		3		2		1	3	2
CO5	3	3	2	2	2	1		3		2		1	3	2
AVG	3	3	2.2	2	1.2	1.4		3		2		1.2	3	2

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**Course Objectives**

1. To understand the concept of automation and robotics with its components.
2. To gain the knowledge in various drive systems and end effectors.
3. To study the different sensors used in robot control.
4. To perform motion analysis and its kinematics along with robot programming
5. To analyze the basics of the industrial applications of robots.

**UNIT I FUNDAMENTALS OF ROBOT****(9)**

Robot – definition – robot anatomy – co-ordinate systems - work envelope - classification – specifications – pitch, yaw and roll - joint notations - speed of motion - pay load - 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 Motor and AC Servo Motors – Features - Applications - Comparison - End Effectors – Grippers – Mechanical, Pneumatic, Hydraulic, Magnetic and Vacuum Grippers; Two Fingere and Three Fingere type - Internal and External Grippers

**UNIT III SENSORS AND MACHINE VISION****(9)**

Sensors - Force sensing - touch and tactile sensors - proximity sensors - non-contact sensors - safety considerations in robotic cell - fail safe hazard sensor systems and compliance mechanism - Machine vision system – camera - frame grabber - sensing and digitizing image data - signal conversion - image storage - lighting techniques - image processing and analysis - data reduction – segmentation - feature extraction.

**UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING****(9)**

Forward and inverse kinematics – manipulators with two and three DOF (in 2D), four DOF (in 3D) – DH matrices - deviations and problems – Robot programming - teach pendant programming - lead through programming - robot programming languages – VAL programming – motion commands - sensor commands - end effector commands

**UNIT V APPLICATIONS OF ROBOTS****(9)**

RGV – AGV - Role of robots in inspection, assembly, material handling, underwater, space and medical fields - Steps involved - Safety Considerations for Robot Operations.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Comprehend the concept of automation and robotics with its components.  
 CO2: Analyze the various drive systems and end effectors with types of robot motions.  
 CO3: Study the different sensors used to control the robots.  
 CO4: Demonstrate the robot kinematics and programming.  
 CO5: Know the applications of robots in automotive industries.

**Text Books**

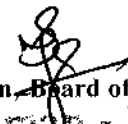
- T1 M.P.Groover, - Industrial Robotics – Technology, Programming and Applications, McGraw-Hill, 2012.  
 T2 Fu, K.S. Gonzalz, R.C., and Lee C.S.G., - Robotics Control, Sensing, Vision and Intelligence, McGraw-Hill Book Co., 1987  
 T3 R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.

**References**

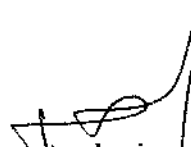
- R1 Yoram Koren, - Robotics for Engineers, McGraw-Hill Book Co., 1992  
 R2 Tadej Bajd, Matjaž Mihelj, Marko Munih, "Introduction to Robotics", Springer, 2013.  
 R3 Robert J. Schilling, "Fundamentals of Robotics, Analysis and Control", PHI Learning, 2009.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1	1	2	1	1	1	1	1	1	1	1	2	1	2
CO2	1	2	1	2	1	2	1	1	2	2	1	2	2	1
CO3	1	1	1	2	1	1	1	1	1	1	1	2	1	2
CO4	1	1	2	2	2	2	1	1	2	2	1	1	1	2
CO5	2	2	2	1	1	1	1	2	1	2	1	1	2	1
AVG	1.2	1.4	1.6	1.6	1.2	1.4	1	1.2	1.4	1.4	1	1.6	1.4	1.6

  
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**Course Objectives**

1. To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles
2. To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and testing the concepts for new product design and development.
5. Applying the principles of Industrial design and prototype for new product design and development.

**UNIT I INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT (9)**

Introduction – Characteristics of Successful Product Development – People involved in Product Design and Development – Duration and Cost of Product Development – The Challenges of Product Development – The Product Development Process – Concept Development: The Front End Process – Adapting the Generic Product Development Process – Product Development Process Flows – Product Development Organizations.

**UNIT II OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING (9)**

Opportunity Identification: Definition – Types of Opportunities – Tournament Structure of Opportunity Identification – Effective Opportunity Tournaments – Opportunity Identification Process – Product Planning: Four types of Product Development Projects – The Process of Product Planning.

**UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS (9)**

Identifying Customer Needs: The Importance of Latent Needs – The Process of Identifying Customer Needs. Product Specifications: Definition – Time of Specifications Establishment – Establishing Target Specifications – Setting the Final Specifications, Customer Experience (CX) Design: Emphasis on emotional and experiential aspects of product use.

**UNIT IV CONCEPT GENERATION, SELECTION & TESTING (9)**

Concept Generation: Activity of Concept Generation – Structured Approach – Five step method of Concept Generation. Concept Selection: Methodology – Concept Screening and Concepts Scoring. Concept testing: Seven Step activities of concept testing. TRIZ (Theory of Inventive Problem Solving) and brainstorming methodologies

**UNIT V INDUSTRIAL DESIGN & PROTOTYPING (9)**

Industrial Design: Need and Impact – Industrial Design Process. Prototyping – Principles of Prototyping – Prototyping Technologies – Planning for Prototypes, Eco-friendly materials and processes, Additive manufacturing (3D printing) and digital twin technologies

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the principles of the generic product development process and organizational structures.
- CO2: Identify opportunities and plan effectively for product development.
- CO3: Conduct customer needs analysis and establish product specifications.
- CO4: Generate, evaluate, and test concepts for innovative product designs.
- CO5: Apply industrial design principles and advanced prototyping techniques.

**Text Books**

- T1 Ulrich K.T., Eppinger S. D. and Anita Goyal, "Product Design and Development" McGraw-Hill Education; 7 edition, 2020.
- T2 Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
- T3 Rosenthal S., "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN1-55623-603-4.

**References**

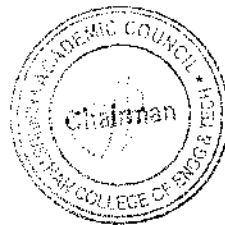
- R1 Jamnia. A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.

- R2 Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.  
 R3 Pugh.S, "Total Design Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, 1991, ISBN0-202-41639-5

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CO1	3	3	2	2	3	1	2	-	1	2	-	2	3	2
CO2	3	3	3	3	2	-	2	-	2	3	-	2	3	2
CO3	3	3	3	3	3	-	1	-	2	2	-	2	3	3
CO4	3	2	3	3	3	-	2	-	2	3	2	2	3	3
CO5	3	2	3	3	3	2	2	-	1	3	2	3	3	3
AVG	3	2.6	2.8	2.8	2.8	1.0	1.8	-	1.6	2.6	1.3	2.2	3.0	2.6

  
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**Course Objectives**

1. To introduce the concept of environmental design and industrial ecology.
2. To impart knowledge about air pollution and its effects on the environment.
3. To enlighten the students with knowledge about noise and its effects on the environment.
4. To enlighten the students with knowledge about water pollution and its effects on the environment.
5. To introduce the concept of green co-rating and its need

**UNIT I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT (9)**

Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage Material flow and cycles – Material recycling – Emission less manufacturing- Industrial Ecology – Pollution prevention – Reduction of toxic emission – design for recycle.

**UNIT II AIR POLLUTION SAMPLING AND MEASUREMENT (9)**

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stabilitywind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation-the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dioxide, carbon monoxide, oxidants and ozone.

**UNIT III NOISE POLLUTION AND CONTROL (9)**

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise-Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

**UNIT IV WATER DEMAND AND WATER QUALITY (9)**

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

**UNIT V GREEN CO-RATING (9)**

Ecological Footprint - Need For Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage- Assessment Process – Types Of Rating – Green Co-Benefits – Case Studies Of Green Co-Rating

**TOTAL: 45 PERIODS****Course Outcomes**

**At the end of this course students will be able to:**

- CO1: Know the environmental design and selection of eco-friendly materials.
- CO2: Analyze manufacturing processes towards minimization or prevention of air pollution.
- CO3: Analyze manufacturing processes towards minimization or prevention of noise pollution.
- CO4: Analyze manufacturing processes towards minimization or prevention of water pollution
- CO5: Evaluate green co-rating and its benefits.

**Text Books**

T1 Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010


T2 Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993.

**References**

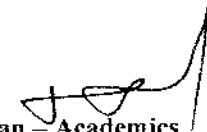
- R1 World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
- R2 Rao M.N. and Dutta A.K. “Wastewater treatment”, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1	3	-	2	-	-	3	-	-	-	3	-	3	1
CO2	1	2	3	1	1	-	-	-	-	-	-	-	1	1
CO3	2	3	3	1	1	-	-	-	-	-	-	-	1	1
CO4	1	3	3	1	1	-	-	-	-	-	-	-	1	1
CO5	-	2	2		1	-	3	-	-	-	-	-	2	1
AVG	1.1	2.4	2.4	1.8	1	-	3	-	-	-	3	-	2.2	1

  
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**Course Objectives**

1. To make the students to understand the concepts of Environmental Sustainability & Impact Assessment
2. To familiarize the students in environmental decision making procedure.
3. Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities
4. To provide information on the environmental consequences for decision making
5. To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

**UNIT I ENVIRONMENTAL IMPACTASSESSMENT****(9)**

Environmental impact assessment objectives –rationale and historical development of EIA -Conceptual frameworks for EIA Legislative development – European community directive –Hungarian directive.

**UNIT II ENVIRONMENTAL DECISIONMAKING****(9)**

Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts-Socio economic impact assessment.

**UNIT III ENVIRONMENTAL POLICY,PLANNING AND LEGISLATION****(9)**

Regional spatial planning and policy –Cumulative effects assessment – Planning for climate change, uncertainty and risk.

**UNIT IV LIFE CYCLE ASSESSMENT****(9)**

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Productstewardship, design, durability and justifiability, measurement techniques and reporting

**UNIT V SUSTAINABLE URBANECONOMIC DEVELOPMENT****(9)**

Spatial economics – Knowledge economy and urban regions, Smart Cities and Sustainable Urbanization, Sustainable Transportation Systems

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Students will be able to comprehend the objectives, historical developments, and legislative frameworks of EIA and apply conceptual methodologies to assess environmental impacts effectively.
- CO2: Students will develop the ability to implement strategic environmental assessment techniques and sustainability appraisals to mitigate and manage environmental and socio-economic impacts.
- CO3: Students will be capable of evaluating regional and spatial planning policies while addressing climate change, uncertainty, and risk through informed decision-making.
- CO4: Students will learn to perform life cycle assessments and integrate ecological footprinting, product stewardship, and design-for-environment strategies in sustainable product development.
- CO5: Students will acquire expertise in fostering sustainable urban growth by leveraging smart city technologies, green infrastructure, and circular economy principles for resilient urban planning.

**Text Books**

- T1 The Application of Science in Environmental Impact Assessment, by Aaron J. MacKimon, Peter Duinker, Tony R. Walker, Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194
- T2 Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
- T3 Rosenthal S., "Effective Product Design and Development", Business One Orwin, Homewood. 1992, ISBN1-55623-603-4.

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- R1 Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.  
 R2 Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.  
 R3 Pugh.S, "Total Design Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, 1991, ISBN0-202-41639-5

CO PO MAPPING

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CO2	3	3	3	3	2	-	2	-	2	3	-	2	3	2
CO3	3	3	3	3	3	-	1	-	2	2	-	2	3	3
CO4	3	2	3	3	3	-	2	-	2	3	2	2	3	3
CO5	3	2	3	3	3	2	2	-	1	3	2	3	3	3
AVG	3	2.6	2.8	2.8	2.8	1.0	1.8	-	1.6	2.6	1.3	2.2	3.0	2.6

  
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**Course Objectives**

1. To Understanding the fundamentals of wind energy technology
2. To design and analyze the existing and innovative blade profile.
3. To assess the performance of the wind turbine
4. To Understand about the selection of sites and installation of turbine.
5. To Understand wind farming and wind energy Economics.

**UNIT I INTRODUCTION**

(9)

Need for Maintenance – importance, classification of maintenance work-basic problem diagnosis. Maintenance of vehicle systems – power pack, tyres, safety systems. Scheduled maintenance services -service intervals – On-board diagnostics, Computerized engine analyzer study and practice- OBD and scan tools

**UNIT II MAINTENANCE OF WORKSHOP RECORDS AND SCHEDULE**

(9)

Importance of maintenance, scheduled and unscheduled maintenance, requirements of maintenance, preparation of check lists, vehicle down time, vehicle inspection, inspection schedule, maintenance of records, reports log books, trip sheets and other forms, safety precautions in maintenance, fleet maintenance requirement, work shop layout, tools and equipment, spare parts and lubricants stocking, manpower, training, workshop management, warranty, replacement policy.

**UNIT III VEHICLE SYSTEM MAINTENAN**

(9)

Clutch- adjustment and service, Maintenance and Service of Hydraulic brake, Bleeding of brakes, Checking ABS and components. Maintenance and Service of McPherson strut, coil spring, tyre wear, measurement of read depth and tyre rotation, Computerized wheel balancing & wheel alignment, Maintenance and Service of steering linkage, steering column, Rack and pinion steering

**UNIT IV MAINTENANCE OF AUXILIARY SYSTEMS**

(9)

Servicing of fuel system of different types of vehicles, maintenance of fuel system of different types of vehicle, calibration and tuning of engine for optimum fuel supply, maintenance of cooling system, water pump, radiator, thermostat, anticorrosion and antifreeze additives, maintenance of lubrication system, different grades of oil, lubricant oil additive, lubricating oil changing, greasing of part, minor and major repairs of body parts, maintenance of door locking mechanism, maintenance of window glass actuating system

**UNIT V SIMULATION OF SAFETY CONCEPT**

(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. Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system Interactions.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understanding the fundamentals of wind energy technology.  
 CO2: Able to design and analyze the existing and innovative blade profile.  
 CO3: Able to assess the performance of the wind turbine  
 CO4: Understanding about the selection of sites and installation of turbines.  
 CO5: Understanding wind farming and wind energy Economics.

**Text Books**

- T1 5th Edition, Advanced Automotive Fault Diagnosis Automotive Technology: Vehicle Maintenance and Repair By Tom Denton  
 T2 Safety Management System and Documentation Training Programme Handbook by S. V. Paul ISBN: 978812392344

**References**

- R1 Ed May, "Automotive Mechanics Volume One" and Two. Mc Graw Hill Publications, Tenth edition. 2018

R2 Bosch Automotive Handbook, Tenth Edition, 2018

R3 Jack Erjavek, A systems approach to Automotive Technology, Cengage Learning, 5th Edition, 20

### CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
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CO5	2	1	2	2	1	3	2	2	2	3	1	3	1	3
AVG	2.8	1	2	2	1	2.2	2.4	2	1.6	1.8	1.2	2.8	1.6	2.2

  
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**Course Objectives**

1. To provide knowledge about various renewable energy technologies
2. To study the solar energy measurement and designing of various solar energy utilized systems.
3. To provide knowledge about wind energy system
4. To understand the applications of energy from waste and designing of bio gas plant.
5. To gain knowledge about application of various renewable energy technologies.

**UNIT I INTRODUCTION**

(9)

Primary energy sources, renewable vs. non-renewable primary energy sources, renewable energy resources in India, Current usage of renewable energy sources in India, future potential of renewable energy in power production and development of renewable energy technologies

**UNIT II SOLAR ENERGY**

(9)

Principles of solar energy collection - solar radiation - measurements - instruments - data and estimation- types of collectors - characteristics and design principles of different type of collectors, performance and testing of collectors - Solar water and air heaters - performance and applications - solar cooling - solar drying - solar ponds - Solar tower concept - solar furnace.

**UNIT III WIND ENERGY**

(9)

Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, wind turbine components, wind energy conversion systems (WECS), Classification of WECS devices, wind electric generating and control systems, characteristics and applications

**UNIT IV BIO ENERGY**

(9)

Energy from biomass, Principle of biomass conversion technologies/process and their classification, Bio gas generation, types of biogas plants, selection of site for biogas plant, classification of biogas plants, Advantage and disadvantages of biogas generation, thermal gasification of biomass, biomass gasifies, Application of biomass and biogas plants and their economics

**UNIT V OTHER TYPES OF ENERGY**

(9)

Energy conversion from Hydrogen and Fuel cells, Geo thermal energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants and their economics.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Attained knowledge about various renewable energy technologies.  
 CO2: Calculate the performance of solar collectors.  
 CO3: Understand the concept of various wind energy system.  
 CO4: Develop skills in bio energy.  
 CO5: Attained knowledge about various application of renewable energy technologies

**Text Books**

- T1 Rai G.D, "Non conventional Energy sources" 4th edition (24th Reprint), Khanna Publishers, New Delhi, 2009.  
 T2 Kothari, "Renewable Energy Sources and Emerging Technologies", Eastern Economy Edition, 2009.

**References**

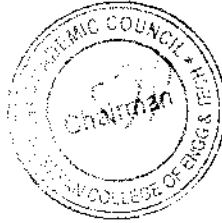
- R1 Sukhatme. S.P., "Solar Energy, Principles of Thermal Collection and Storage", 3rd Edition, Tata MCGraw Hill, 2008.  
 R2 S.Rao and Parulchar, "Energy Technology - Non conventional, Renewable and Conventional, 3rd Edition, Khanna Publishers, 2009.


- R3 Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi. David M. Mousdale – "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA2017.

CO PO MAPPING

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CO4	3	1	2	2	1	2	3	2	2	1	1	3	1	3
CO5	2	1	2	2	1	3	2	2	2	3	1	3	1	3
AVG	2.8	1	2	2	1	2.2	2.4	2	1.6	1.8	1.2	2.8	1.6	2.2

  
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**Course Objectives**

1. To acquire the knowledge about the basic design considerations.
2. To understand the concept of designing piston and connecting rod.
3. To get practice of designing crankshaft and balancing weight calculation.
4. To obtain knowledge about designing of flywheel.
5. To impart the knowledge about designing valves and valve train.

**UNIT I INTRODUCTION**

(9)

Engineering materials – Properties, Limit, Fits and Tolerances. Material Selection and design of push Rod, design of Cylinder.

**UNIT II DESIGN OF PISTON AND CONNECTING ROD**

(9)

Material Selection and Design of Piston – Piston Pin – Piston Rings. Design of Connecting Rod – Small end, big end and Shank Portion. Design of big end cap bolts.

**UNIT III DESIGN OF CRANK SHAFT**

(9)

Material Selection and Design of crank shaft – Balancing weight calculation – Development of Short and Long arms – Significance of Firing Order.

**UNIT IV DESIGN OF FLYWHEEL**

(9)

Material Selection and Design of Flywheel – Turning Moment Diagram – Stresses on the rim – Design of hubs and arms – Determination of mass of Flywheel.

**UNIT V DESIGN OF VALVES AND VALVE TRAIN.**

(9)

Material Selection and Design of valves and Manifolds – Intake and Exhaust - Valve Spring design. Design of Tappets.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Identify the basic design concept of engine components.
- CO2: Understand the concept of designing piston and connecting rod
- CO3: Know the design considerations of crankshaft.
- CO4: Calculate the flywheel mass and dimensions.
- CO5: Explain the designing procedure of valves and valve train

**Text Books**

T1 Khurmi, R.S. & Gupta, J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd. 2001

**References**

- R1 Jain.R.K, "Machine Design", Khanna Publishers, New Delhi, 2005
- R2 Giri.N.K, "Automobile Mechanics". Khanna Publishers, New Delhi, 2007.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	3	2	-	-	-	-	-	3	3	2
CO2	3	3	3	3	3	3	-	-	-	-	-	2	3	2
CO3	3	3	3	3	3	3	-	-	-	-	-	3	3	2
CO4	3	3	3	3	3	3	-	-	-	-	-	3	2	3
CO5	3	3	3	3	3	3	-	-	-	-	-	3	2	3
AVG	3	3	3	3	3	2.8	-	-	-	-	-	2.8	2.6	2.4

  
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**Course Objectives**

1. To impart basic knowledge in finite element method.
2. To provide knowledge in 1D elements.
3. To provide knowledge in 2D elements.
4. To study heat conduction problems using finite element method.
5. To provide knowledge in higher order and isoparametric elements.

**UNIT I INTRODUCTION****(09)**

Historical Background – Mathematical Modeling of field problems in Engineering –Governing Equations – Discrete and continuous models– Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

**UNIT II ONE-DIMENSIONAL PROBLEMS****(09)**

Coordinate system types. Shape function of 1D bar element - Problems in 1D bar element and two node truss element-problems in the 2D truss. Introduction to the beam element.

**UNIT III TWO-DIMENSIONAL (2D) ELEMENTS****(09)**

Shape function for linear triangular element - Finite element formulation - Constant Strain Triangular (CST) element - Plane stress, Plane strain - Axisymmetric elements - Problems.

**UNIT IV HEAT TRANSFER APPLICATIONS****(09)**

Shape function for 1D and 2D triangular element heat conduction, heat generation with convective boundary conditions for the linear element. Thermal stress – heat transfer

**UNIT V HIGHER ORDER AND ISOPARAMETRIC ELEMENT****(09)**

Selection of order of polynomial-linear, simplex, complex and multiplex elements. Mesh refinement methods and convergence requirements. Iso parametric element. Shape functions for a 2-D four noded and eight noded Isoparametric rectangular element using the natural coordinate system - problems. Gaussian quadrature method-problems.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Apply the numerical methods to formulate the simple finite element problems.  
 CO2: Apply one dimensional finite element method to solve bar,beam and truss type problems  
 CO3: Apply finite element method for plane stress, plane strain and axisymmetric conditions  
 CO4: Determine temperature distribution of one- & two-dimensional and heat transfer problems using one- & two-dimensional finite elements  
 CO5: Apply the numerical methods to formulate the higher order and isoperametric problems

**Text Books**

- T1 S. S. Rao, Finite Element Method in Engineering, Elsevier India, 2017  
 T2 David V. Hutton. Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,2017  
 T3 Robert D. Cook, s. David, Malkucs Michael E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New Delhi,2001.

**References**


- R1 T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements Engineering, Pearson Education, New Delhi, 2011.  
 R2 S. S. Bhavikati, Finite Element Analysis, New Age International Publishers, 2015

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	3	2	1	1	-	1	-	2	-	2	3	2
CO2	3	3	2	2	1	2	-	1	-	2	-	1	3	2
CO3	3	3	2	2	1	2	-	1	-	2	-	1	3	2
CO4	3	3	2	2	1	1	-	1	-	2	-	1	3	2
CO5	3	3	2	2	2	1	-	1	-	2	-	1	3	2
AVG	3	3	2.2	2	1.2	1.4	-	1	-	2	-	1.2	3	2

  
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**Course Objectives**

1. To understand the basic fundamentals of automobile engineering
2. To acquire knowledge of automotive engines
3. To impart knowledge of various power transmission unit
4. To understand the principles of steering and brake systems
5. To know about automotive electrical systems and its functions

**UNIT I INTRODUCTION****(8)**

Automobile - Components of an automobile - Classification of automobiles - Layout of chassis - Types of drives front wheel - rear wheel - four wheel.

**UNIT II IC ENGINES****(9)**

Classification - ignition system - Two stroke and four stroke engines – scavenging - Cooling and Lubrication systems - Fuel Supply system – air fuel ratio - Carburetor

**UNIT III TRANSMISSION SYSTEM****(10)**

Clutch - Function - single plate - multi plate - friction clutches - Centrifugal and semi centrifugal clutch - Gear Box - slide mesh - constant mesh and synchromesh gear box - Torque convertor - Propeller shaft and rear axle- Universal joint – Differential.

**UNIT IV STEERING AND BRAKE****(9)**

Steering system - function and principle - Ackerman and Davis steering principles - wheel alignment –steering gear boxes. Brakes - Mechanical - hydraulic and vacuum brake - master cylinder - wheel cylinder.

**UNIT V ELECTRICAL SYSTEMS****(9)**

Battery – types - Dynamo and Alternator – Cutout relay - Diagram of Wiring system - Lighting System and Accessories- Windscreen Wipers – Horn – Speedometer – Heater and Air conditioning.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Provides basic platform knowledge of automobile engineering  
 CO2: Acquired the knowledge the working principal of petrol and diesel engines  
 CO3: Interpret the method of power transmission unit  
 CO4: Built knowledge of steering and brake  
 CO5: Acquired the knowledge of automotive electrical systems and functioning

**Text Books**


- T1 Kirpal Singh, Automotive Engineering, Vol. I & II, Standard Publishers, New Delhi, 2010.  
 T2 Gupta, S K “A Textbook of Automobile Engineering”, Chand Publishing, 2013

**References**

- R1 Rajput, R K, “A Textbook of Automobile Engineering”. Firewall Media, 2007.  
 R2 Butterworth-Heinemann, “Automobile and Mechanical Electrical Systems”, Tom Denton Publisher, 2011.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	1	1		1	1	2
CO2	3	3	3	2	2	1	1	1		1	1	2
CO3	3	3	3	2	2	1	1	1		1	1	2
CO4	3	3	3	2	2	1	1	1		1	1	2
CO5	3	3	3	2	2	1	1	1		1	1	2
AVG	3	3	3	2	2	1	1	1		1	1	2

  
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**Course Objectives**

1. Understand chassis construction, types of layouts, frame varieties, and loads on vehicle frames. Explore vehicle body design details.
2. Learn axle types, wheel geometry, steering mechanisms, gearboxes, and the concepts of slip angle, oversteer, understeer, and power steering.
3. Comprehend driveline components, torque reactions, propeller shaft, universal joints, differential functions, types, and rear axle construction.
4. Understand the need for suspension systems, including various spring types, shock absorbers, and stabilizer bars.
5. Explore brake types, systems, wheel functions, balancing, rim construction, tyre types, and maintenance requirements.

**UNIT I CHASSIS AND FRAMES****(9)**

Chassis – basic construction – types of Chassis layout – based on power train – Frames – types – various loads acting on vehicle frame – Vehicle body design details.

**UNIT II FRONT AXLE AND STEERING SYSTEM****(9)**

Axle – types of front and stub axles – wheel geometry – true rolling motion – Ackerman's and Davis steering mechanisms – steering linkages – different types of steering gear boxes – slip angle – over steer and under steer – reversible and irreversible steering – power steering.

**UNIT III DRIVELINE, FINAL DRIVE AND REAR AXLE****(9)**

Driveline – thrust effects – torque reactions – side thrust – Propeller shaft – universal joints – final drive – differential – constructional details – functions – types - non slip differential – differential locks – rear axles – construction – types – twist beam rear axle – various loads acting on rear axles.

**UNIT IV SUSPENSION SYSTEMS****(9)**

Suspension systems – need – constructional details and characteristics of single leaf, multi-leaf spring, coil and torsion bar springs – rubber, pneumatic and hydro elastic suspension spring systems – independent suspension system – shock absorbers – radius rods – stabilizer bar.

**UNIT V BRAKING SYSTEMS, WHEELS AND TYRES****(9)**

Brakes – need – classification – drum and disc brakes – hydraulic, mechanical, pneumatic braking systems – power assisted braking system – servo brakes – braking parameters – Wheels – functions – types – balancing – rims – constructional details – types – Tyres – classification – constructional details – maintenance.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Analyze chassis construction, identify layouts, understand frame variations, and consider vehicle body design details.
- CO2: Evaluate axle types, wheel geometry, steering mechanisms, and grasp steering dynamics, including power steering.
- CO3: Comprehend driveline components, torque reactions, differential functions, and rear axle construction principles.
- CO4: Understand the need for suspension systems, including various spring types, shock absorbers, and stabilizer bars.
- CO5: Expertise in brake types, systems, wheel functions, balancing, rim construction, tire types, and maintenance for effective automotive decision-making.

**Text Books**

- T1 Kirpal Singh, "Automobile Engineering – Volume 1", Standard Publishes-Distributors, Delhi, 2012.
- T2 R.K Rajput. "A Textbook of Automobile Engineering", Laxmi Publications Private Limited, 2007.

T3 N.K. Giri, "Automotive Mechanics" Khanna Publishers, New Delhi, 2005.

**References**

- R1 Heldt P.M., "Automotive Chassis", 2012, Literary Licensing, LLC
- R2 Newton Steeds and Garret, "Motor Vehicles" 13th Edition, Butterworth, London, 2005.
- R3 Heinz Hazler, "Modern Vehicle Technology", Butterworth, London, 2005.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2	2	1	1	1	-	1	1	2	3	2
CO2	3	3	3	2	2	1	1	1	-	1	1	2	3	2
CO3	3	3	3	2	2	1	1	1	-	1	1	2	3	2
CO4	3	3	3	2	2	1	1	1	-	1	1	2	3	2
CO5	3	3	3	2	2	1	1	1	-	1	1	2	3	2
AVG	3	3	3	2	2	1	1	1	-	1	1	2	3	2

  
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**Course Objectives**

1. Understand the role of transmissions, construction and working of clutches and gear boxes
2. Master the hydraulic transmission like fluid flywheel and torque converter
3. Comprehend automatic transmission elements like planetary gear sets, Wilson gear box etc.,
4. Recognize the applications of automatic transmission like CVT.
5. Explore the working of hydrostatic and electric drive.

**UNIT 01 MANUAL TRANSMISSIONS**

(9)

Requirements of transmission system – Clutches– Single plate and Diaphragm type. Need of gear box. Types – Sliding mesh, constant mesh, Synchronesh gear box. Drawback of manual transmission.

**UNIT 02 HYDRAULIC TRANSMISSION**

(9)

Fluid coupling, Method of reducing Drag torque, Torque Converter – Single phase, Poly phase and Multiphase. Constructional details and Performance Characteristics,

**UNIT 03 EPICYCLIC GEAR BOX**

(9)

Planetary Gear Box - Wilson Gear Box - Cotal Electromagnetic Transmission – Hydraulic Control System.

**UNIT 04 AUTOMATIC TRANSMISSION APPLICATIONS**

(9)

Continuously Variable Transmission (CVT) – Operations and its Types. transmission fluids, Types of transmission fluids and their properties, Signs of transmission fluid problems, Preventive maintenance tips for extending transmission life.

**UNIT 05 HYDROSTATIC AND ELECTRIC DRIVE**

(9)

Hydrostatic Drive – Janny Hydrostatic Drive – Advantages and Limitations. Electric drive-types- Principle of early and modified Ward Leonard Control system-Advantages & limitations.

**TOTAL: 45 PERIODS****Course Outcomes****At the end of this course the student will be able to**

- CO1: Understand the role of transmissions, construction and working of clutches and gear boxes  
 CO2: Identify the hydraulic transmission like fluid flywheel and torque converter  
 CO3: Comprehend automatic transmission elements like planetary gear sets, Wilson gear box etc.,  
 CO4: Recognize the applications of automatic transmission like CVT.  
 CO5: Explore the working of hydrostatic and electric drive.

**Text Books**


- T1 Harald Naunheimer, Bernd Bertsche, Joachim Ryborz. "Automotive Transmissions: Fundamentals. Selections, Design and Applications" Wolfgang Novak Publisher: Springer 2011 ISBN-13: 978-3642173319  
 T2 James D. Halderman "Automatic Transmissions and Transaxles" Pearson, 2017 ISBN-13: 978-0134169870  
 T3 Tim Gilles, "Automotive Service: Inspection, Maintenance, Repair" Publisher: Cengage Learning, 2018 ISBN-13: 978-1305110595

**References**

- R1 Heldt, P.M., Torque converters, Chilton Book Co., 1962  
 R2 Crouse, W.H., Anglin, D.L., Automotive Transmission and Power Trains construction, McGraw Hill, 1976.  
 R3 Iqbal Husain, Electric And Hybrid Vehicles Design Fundamentals, CRC PRESS Boca Raton London New York Washington, D.C.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2	2	1	1	1	-	1	1	2	3	2
CO2	3	3	3	2	2	1	1	1	-	1	1	2	3	2
CO3	3	3	3	2	2	1	1	1	-	1	1	2	3	2
CO4	3	3	3	2	2	1	1	1	-	1	1	2	3	2
CO5	3	3	3	2	2	1	1	1	-	1	1	2	3	2
AVG	3	3	3	2	2	1	1	1	-	1	1	2	3	2

  
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**Course Objectives**

1. To understand the Energy Storage device
2. To know about features of Battery Management System
3. To discuss about the various aspects of Battery Charge
4. To learn the Fuel Cell and its Construction
5. To get an exposure about the Design of battery BMS

**UNIT I INTRODUCTION**

(9)

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging

**UNIT II BATTERY MANAGEMENT SYSTEM REQUIREMENT**

(9)

Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of-charge estimation, Cell total energy and cell total power

**UNIT III BATTERY CHARGE AND HEALTH ESTIMATION, CELL BALANCING**

(9)

Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing

**UNIT IV FUEL CELL**

(9)

Fuels for Fuel Cells: Hydrogen, methane, methanol – Sources and preparation, reformation processes for hydrogen – clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel.

**UNIT V DESIGN OF BATTERY BMS**

(9)

Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Interpret the role of battery management system
- CO2: Identify the requirements of Battery Management System
- CO3: Interpret the concept associated with battery charging / discharging process
- CO4: Understand the construction of Fuel cell
- CO5: Design the model of battery pack

**Text Books**

- T1 Plett, Gregory L. Battery management systems, Volume I: Battery modeling. Artech House. 2015.
- T2 Bergveld, H.J., Kruijt, W.S., Notten, P.H.L "Battery Management Systems -Design by Modelling" Philips Research Book Series 2002.
- T3 Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House. 2010

**References**

- R1 Pop, Valer, et al. Battery management systems: Accurate state-of-charge indication for battery-powered applications. Vol. 9. Springer Science & Business Media, 2008.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	2	1	-	1	1	-	1	-	1	1	2
CO2	3	2	2	2	1	-	1	1	-	1	-	1	2	1
CO3	3	1	2	2	1	1	1	1	-	1	-	1	1	2
CO4	2	1	2	1	1	1	1	1	-	1	-	1	2	1
CO5	2	2	2	1	1	1	1	1	-	1	-	1	1	1
AVG	2.6	1.6	2	1.6	1	1	1	1	-	1	-	1	1.4	1.4

  
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**Course Objectives**

1. To select suitable sensors for measuring parameters in automotive systems.
2. To choose the appropriate actuator and driver for automotive applications.
3. To outline the concepts of embedded systems.
4. To design of hardware model for automotive system using microcontroller.
5. To compare the wired and wireless communication protocols.

**UNIT I SENSORS**

(9)

Introduction to automotive sensors .Proximity sensors- inductive, capacitive, magnetic, Photoelectric, Ultrasonic sensors, Thermistor, Thermocouple, Hall effect sensor, Load cell, Optical rain sensor, Liquid level sensor, Lambda sensor, NOX sensor, MAP and MAF, Knock sensor, Angle sensor, Vibration sensor. Acceleration sensor, Pressure sensor, RPM sensor, Torque sensors, Position sensor..

**UNIT II ACTUATORS**

(9)

Solenoid –Types, Solenoid Switching, Relays and Optoisolators – Electromechanical relay, driving a relay, solid-state relay, Reed switch , Optoisolator, Servo and stepper motors, Piezoelectric Actuators, Actuator Driver - H Bridge driver, Door actuator driver, Stepper motor driver, Transistor driver, Signal conditioner - Amplifier, Filter, Data Acquisition.

**UNIT III INTRODUCTION TO EMBEDDED SYSTEM**

(9)

Introduction, Embedded system design process, Microcontroller v/s microprocessor, Architecture of 8/32 Bit controller - ADC, DAC, Memory, Timer and interrupts. Software development in IDE - Hardware/ Software configuration, Models of programs - Assembly, linking and loading. Structure of the Program - variables, functions, loops and I/O parameters.

**UNIT IV INTERFACING WITH MICROCONTROLLER**

(9)

Sensor interfacing: Analog and digital sensor, keyboard interface with 8/32 bit controller. Actuator Interfacing: Motor control applications - Pulse width modulation (PWM), LCD display, relay and solenoid Interfacing with 8/32 bit controller. Serial communication interfacing.

**UNIT V COMMUNICATION PROTOCOLS**

(9)

Introduction to Communication protocol in embedded systems, Wired communication protocols – SPI, I2C and USB, CAN. Wireless communication protocols - Bluetooth HC05, Wi-Fi, RF transmitter and receiver, Internet of Things (IoT).

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Select suitable sensors for measuring parameters in automotive systems.  
 CO2: Choose the appropriate actuator and driver for automotive applications.  
 CO3: Outline the concepts of embedded systems.  
 CO4: Design of hardware model for automotive system using microcontroller.  
 CO5: Compare the wired and wireless communication protocols.

**Text Books**

- T1 Electronic control unit (ECU). In: Reif K. (eds) Gasoline Engine Management. Bosch Professional Automotive Information by Kaiser M. (2015)  
 T2 Sensors and Transducers - Ronald K. Jurgen, —, 2nd Edition, SAE, 2003  
 T3 Automotive Electronics Design Fundamentals 1st ed. 2015 Edition by Najamuz Zaman

**References**


- R1 Automotive Sensors, BOSCH. 20Q2  
 R2 Comprehensible Guide to Controller Area Network Paperback – 1 Aug 2005 by Wilfried Voss

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	-	3	-	2	1	-	2	-	1	2	1
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CO4	2	2	2	-	3	-	2	1	-	2	-	-	2	1
CO5	2	2	2	-	3	-	2	1	-	2	-	1	2	1
AVG	2.6	2.2	2	-	3	-	2	1	-	2	-	1	2	1

  
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**Course Objectives**

1. To Provide deep understanding of vehicle propulsion options and driveline.
2. Establish approaches and procedures to analyzing and predicting vehicle performance.
3. To provide a fundamental understanding of vehicle dynamics as applied to wheeled vehicles.
4. To provide an introduction to the design and analysis of vehicle structures.
5. To empower the students with the capability to analysis, synthesis, and evaluate various technologies and integration challenges associated with the electric and hybrid vehicles.

**UNIT I BASIC VEHICLE CHARACTERISTICS****(9)**

Vehicle concepts, centre of gravity position, static and dynamic loads and weight distributions, front, rear and all wheel drive. Adhesion coefficient and influencing factors. Traction, braking and resistance to motion. Engine characteristics & fuel maps. Determination of fuel consumption. Energy aspects. Legislative Drive Cycles.

**UNIT II INTAKE SYSTEM DESIGN****(9)**

Maximising the air/fuel charge in every cylinder: intake system design, supercharging & turbo-charging. Fuel systems, combustion control and engine management systems. Mechanical design of high performance two and four stroke petrol and diesel motorsport engines.

**UNIT III VEHICLE DYNAMICS****(9)**

Vehicle ride, ride modeling and terrain modeling. Vehicle handling, steady-state and transient handling. Tyre characteristics and tyre modeling. Suspension system types, typical designs and practical implications. Kinematics, wheel motion control, instantaneous centres of rotation. Steering system, steering kinematics and compliance.

**UNIT IV VEHICLE STRUCTURES****(9)**

Review and analysis of different types of vehicle structures. Load paths and interaction with other vehicle systems. Structural response and stiffness analyses. Design of safety and crash structures.

**UNIT V VEHICLE ELECTRIFICATION AND HYBRIDIZATION****(9)**

Introduction to Hybrid and Electric Vehicles systems and power train architectures. Introduction to Electric Motors, Power Electronics and Electric Drives, and Motor Control. High voltage electrical architectures and the integration of power electronics systems. Hybrid and electric power trains as used in motorsport.

**TOTAL: 45 PERIODS****Course Outcomes**

On successful completion of this course you should be able to:

- CO1: Interpret and apply legislative requirements in generating vehicle concepts and designs.
- CO2: Test and evaluate the physical processes at work during the preparation of the fuel & air mixture and its eventual combustion and emission with particular reference to high engine speeds.
- CO3: Critically evaluate vehicle ride and handling performance and the role of tyre and suspension characteristics.
- CO4: Critically evaluate fundamental properties of metallic and non-metallic material for automotive structures.
- CO5: Demonstrate an ability to design and/or size different Hybrid and Electric Vehicle sub-systems, within the context of vehicle usage, weight, packaging, and range constraints.

**Text Books**

- T1 W. A. Livesey, Andrew Livesey., Advanced Motorsport Engineering, Routledge publisher, 1st edition (29 March 2012)
- T2 Andrew Livesey, Practical Motorsport Engineering. Routledge publisher.2019.

**References**


- R1 Martin H. Howarth , The Design of High Speed Diesel Engines 1966, American Elsevier Publishing Company.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2	-	3	2	-	-	-	1	3	1	2
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CO4	3	3	3	2	-	3	2	-	-	-	2	3	1	2
CO5	3	3	3	2	-	3	2	-	-	-	2	3	1	2
AVG	3	3	3	2	-	3	2	-	-	-	2	3	1	2

  
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**Course Objectives**

1. To Understand Motorsport Electric Vehicle Technology
2. To understand electric power trains influence the dynamic behavior and performance characteristics of motorsport vehicles
3. To Develop and apply practical energy management strategies in motorsport electric vehicles.
4. To Apply Aerodynamic Principles for Racing Efficiency
5. To Proficiently Use Data for Performance Optimization

**UNIT 01 INTRODUCTION TO MOTORSPORT ELECTRIC VEHICLES (9)**

Overview of motorsport electric vehicles, Definition and characteristics - Historical development and evolution- Basic electric vehicle components, Motorsport EV Regulations .

**UNIT 02 ELECTRIC POWER TRAINS (9)**

Electric motor fundamentals - Types of electric motors used in motorsport - Power electronics and motor controllers

**UNIT 03 ENERGY STORAGE SYSTEMS (9)**

Battery technologies and advancements - Battery management systems - Charging infrastructure for motorsport electric vehicles

**UNIT 04 VEHICLE DYNAMICS AND CONTROL SYSTEMS (9)**

Vehicle dynamics in the context of electric vehicles - Traction control systems - Regenerative braking systems, accelerometers, gyroscopes, and advanced position sensors

**UNIT 05 DATA AND ADVANCED TECHNOLOGIES (9)**

Data acquisition systems for motorsport electric vehicles - Telemetry systems and real-time data analysis - Overview of advanced technologies in motorsport EVs - Application of MATLAB in processing and interpreting motorsport data

**TOTAL: 45 PERIODS**

**Course Outcomes**

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

- CO1: Students will exhibit a precise understanding of the functions and characteristics of essential components in motorsport electric vehicles
- CO2: Students will be able to analyze and assess how electric powertrains influence the dynamics and performance of motorsport vehicles.
- CO3: Apply Effective Energy Management Strategies
- CO4: Integrate Aerodynamics for Enhanced Racing Efficiency
- CO5: Proficiently Use Data for Performance Optimization

**Text Books**

- T1 Husain, Iqbal, "Electric and Hybrid Vehicles: Design Fundamentals," CRC Press, 2017
- T2 Larminie, James, and Lowry. John, "Electric Vehicle Technology Explained," Wiley, 2012

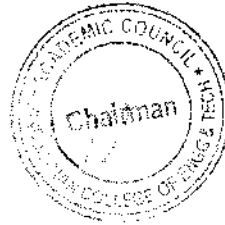
**References**

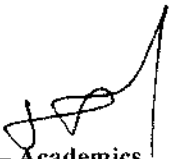
- R1 Hayes, John G., and Goodarzi, G. Abas. "High-Performance Electric Motors," CRC Press, 2018
- R2 Qaisar, Saeed B., "Introduction to Electric Vehicle Technology," CRC Press, 2016

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2	-	3	2	2	-	2	-	3	1	2
CO2	3	3	3	2	-	3	2	1	-	2	-	3	1	2
CO3	3	3	3	2	-	3	2	1	-	2	-	3	1	2
CO4	3	3	3	2	-	3	2	1	-	2	-	3	1	2
CO5	3	3	3	2	-	3	2	1	-	2	-	3	1	2
AVG	3	3	3	2	-	3	2	1.2	-	2	-	3	1	2

  
 Chairman, Board of Studies  
**Chairman - BoS**  
**AUTO - HICET**



  
 Dean - Academics  
**Dean (Academics)**  
**HICET**

**Course Objectives**

1. To learn fundamentals of Automotive noise, vibration and harshness
2. To understand of Forced vibrations of two/many degrees of freedom systems in automobile
3. To understand the various instruments for noise, vibration and harshness
4. To study the Statistical analysis. Frequency analysis of vibration
5. To study the NVH Control systems

**UNIT I NVH IN THE AUTOMOTIVE INDUSTRY (10)**

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

**UNIT II SOUND AND VIBRATION THEORY (10)**

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

**UNIT III TEST FACILITIES AND INSTRUMENTATION (11)**

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

**UNIT IV SIGNAL PROCESSING (7)**

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

**UNIT V NVH CONTROL STRATEGIES & COMFORT (7)**

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

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Learn fundamentals of Automotive Noise, Vibrations and Harshness in EVs and Identify sources of noise and vibrations
- CO2: Understand the forced vibrations of two degrees & many degrees of freedom system and obtain mathematical model of real life Engineering systems
- CO3: Measure sound intensity & noise and use technologies to control NVH.
- CO4: Gain expertise in analyzing forced vibrations in two and multi-degrees of freedom systems. leading to the formulation of mathematical models for real-world engineering applications.
- CO5: Apply the knowledge gained in the due process in designing of a suitable system to reduce

**Text Books**

- T1 Norton M P, Fundamental of Noise and Vibration, Cambridge University Press, 1989
- T2 Munjal M.L., Acoustic Ducts and Mufflers, John Wiley, 1987
- T3 Boris and Kornev, Dynamic Vibration Absorbers, John Wiley, 1993.

**References**

- R1 McConnell K, "Vibration Testing Theory and Practice", John Wiley, 1995
- R2 Ewins D. J., Model Testing : Theory and Practice, John Wiley, 1995.
- R3 Baxa, Noise Control of Internal Combustion Engine, John Wiley, 1984.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	-	2	-	3	3	-	1	2	2	-	-	-	3	2
CO2	3	2	3	-	-	3	2	2	2	-	3	-	2	3
CO3	-	-	3	-	-	2	2	2	2	-	-	-	2	3
CO4	-	-	2	1	3	1	-	-	2	-	3	-	3	3
CO5	3	-	-	3	3	-	-	2	-	-	-	-	3	3
AVG	3	2	2.6	2.4	3	2	2.5	2	2	-	3	-	3	3

  
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**AUTO - HICET**

Dean – Academics  
**Dean (Academics)**  
 HICET

**Course Objectives**

1. To Understand measurement characteristics.
2. To Understand the working of vibration and body test
3. To Know about the measurement analysis.
4. To Understand the working of engine experimental techniques
5. To Understand the working of vehicle experimental techniques

**UNIT I MECHANICAL MEASUREMENT****(9)**

Introduction to measurements – Construction, principle, working of Instruments for measuring force, torque, pressure, temperature, fluid flow, velocity, rotational speed.

**UNIT II VIBRATION AND BODY TEST****(9)**

Vibration measurement instrument – accelerometer and signal conditioning. Dynamic simulation sled testing, methodology, vehicle acceleration measurement and documentation. Dolly roll over test, dolly role over fixture, photographic / video coverage. Vehicle roof strength test – Door system crush test – wind tunnel tests.

**UNIT III CRASH AND BRAKE TEST****(9)**

Crash tests –standards – road hazard impact test for wheel and tyre assemblies, test procedures, failure and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test. procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements.

**UNIT IV ENGINE EXPERIMENTAL TECHNIQUES****(9)**

I.S Code for Engine testing – Instruments for performance testing of engine, Instrumentation for measuring noise, vibration in cylinder, different types of engine tests are performed within the industry.

**UNIT V VEHICLE EXPERIMENTAL TECHNIQUES****(9)**

Laboratory tests- test tracks - Endurance Tests - Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Demonstrate the understanding of engine testing procedures.
- CO2: Develop a measurement strategy for temperature, pressure, mass flow, velocity.
- CO3: Understand sensors and instrumentation, and to analyze and interpret test data.
- CO4: Design new instrumentation that would help in keeping the environment sustainable.
- CO5: Identify industrial engine tests

**Text Books**


- T1 Crouse W H and Anglin D L., "Automotive Mechanics" Tata McGraw Hill Publishing Company, 2004.
- T2 J.G.Giles, Vehicle Operation & Testing, Volume 7 of Automotive technology series. Iliffe,1969
- T3 Richard D. Atkins, "An Introduction to Engine Testing and Development", SAE International 2009.

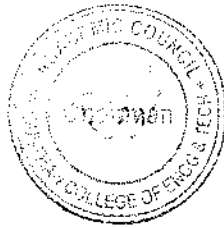
**References**

- R1 Beckwith TG and Buck N L., "Mechanical Measurements", Addition Wesley Publishing Company Limited, 1995.
- R2 Jain R K "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 1999.
- R3 Stockel M W, "Auto Mechanics Fundamentals". Good Heart-Wilcox Co., Inc., 2000.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	1	2	2	2	2	1	1	1	3	3	3
CO2	3	3	2	1	2	2	2	2	1	1	1	2	3	3
CO3	2	3	2	1	2	3	2	2	1	1	1	2	2	3
CO4	3	3	2	1	2	2	2	2	1	1	1	3	3	3
CO5	3	3	2	1	2	2	2	2	1	1	1	3	3	3
AVG	2.8	3	2	1	2	2	2	2	1	1	1	2.4	2.8	3

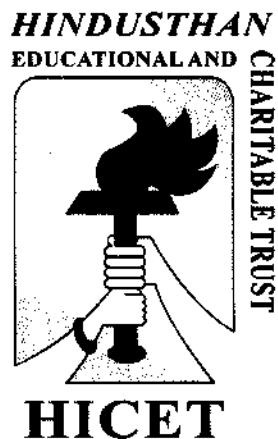
  
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***HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY***  
**(An Autonomous Institution Affiliated to Anna University, Chennai)**  
**(Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' Grade)**  
**Coimbatore - 641 032.**

**B.E. AUTOMOBILE ENGINEERING**



**CHOICE BASED CREDIT SYSTEM**

**Revised Curriculum and Syllabus for the EVEN Semester**  
**For the students admitted during the academic year 2021-2022**  
**Academic year 2024-25**

**2019 R REGULATIONS**





**Hindusthan College of Engineering and Technology**  
 (An Autonomous Institution, Affiliated to Anna University, Chennai  
 Approved by AICTE, New Delhi & Accredited by NAAC with 'A++' Grade)  
 Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu.



## DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

### CBCS PATTERN

### UNDERGRADUATE PROGRAMMES

### B.E. AUTOMOBILE ENGINEERING (UG)

### REGULATION-2019 (Revised on July 2021)

(For the students admitted during the academic year 2021-2022 and onwards)

### SEMESTER I

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21HE1101	Technical English	HS	2	1	0	3	40	60	100
2	21MA1102	Calculus and Linear Algebra	BS	3	1	0	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
3	21PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	21CY1151	Engineering Chemistry	BS	2	0	2	3	50	50	100
5	21CS1151	Python Programming and practices	ES	2	0	2	3	50	50	100
6	21ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
<b>PRACTICAL</b>										
7	21HE1071	Language Competency Enhancement Course - I	HS	0	0	2	1	0	100	100
<b>NON-CREDIT MANDATORY COURSE</b>										
8	21HE1072	Career Guidance Level - I Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
9	21HE1073	Entrepreneurship and Innovation	EEC	1	0	0	0	100	0	100
<b>Total</b>				<b>15</b>	<b>2</b>	<b>12</b>	<b>20</b>	<b>480</b>	<b>420</b>	<b>900</b>
As Per AICTE Norms 3 Weeks Induction Programme is Added in The First Semester as an Audit Course										

**SEMESTER II**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21HE2101	Business English for Engineers	HS	2	1	0	3	40	60	100
2	21MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	40	60	100
3	21ME2101	Engineering Mechanics	ES	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
4	21PH2151	Material Science	BS	2	0	2	3	50	50	100
5	21CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
6	21IT2151	Programming in C	ES	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
7	21ME2001	Engineering Practices	ES	0	0	4	2	60	40	100
8	21HE2071	Language Competency Enhancement Course - II	HS	0	0	2	1	0	100	100
<b>NON-CREDIT MANDATORY COURSE</b>										
9	21HE2072	Career Guidance Level – II Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
<b>Total</b>				<b>17</b>	<b>2</b>	<b>12</b>	<b>22</b>	<b>530</b>	<b>370</b>	<b>900</b>

**SEMESTER III**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21MA3101	Fourier Series and Statistics	BS	3	1	0	4	40	60	100
2	21AU3201	Fluid and Pneumatic Systems	PC	3	1	0	4	40	60	100
3	21AU3202	Engineering Thermodynamics	PC	3	0	0	3	40	60	100
4	21AU3203	Theory of Automotive Engines	PC	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
5	21AU3251	Automotive Structures and Design	PC	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
6	21AU3001	Automotive Components Lab	PC	0	0	3	1.5	60	40	100
7	21AU3002	Computer Aided Drawing Lab	PC	0	0	3	1.5	60	40	100
<b>NON CREDIT MANDATORY COURSE</b>										
8	21MC3191	Indian Constitution	MC	2	0	0	0	100	-	100
9	21HE3072	Career Guidance – Level III Personality, Aptitude and Career Development	EEC	2	0	0	0	100	-	100
10	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	-	100
<b>Total</b>				<b>20</b>	<b>2</b>	<b>8</b>	<b>20</b>	<b>630</b>	<b>370</b>	<b>1000</b>

**SEMESTER IV**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21MA4101	Numerical Methods	BS	3	1	0	4	40	60	100
2	21AU4201	Mechanism and Machine Theory	PC	3	1	0	4	40	60	100
3	21AU4202	Automotive Engine Components Design	PC	3	1	0	4	40	60	100
4	21AU4203	Two and Three Wheelers Technology	PC	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
5	21AU4251	Fundamentals of Heat Transfer	PC	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
6	21AU4001	Computer Aided Automotive Engine Components Lab	PC	0	0	3	1.5	60	40	100
7	21AU4002	Two and Three Wheelers Technology Lab	PC	0	0	3	1.5	60	40	100
<b>NON CREDIT MANDATORY COURSE</b>										
8	21MC4191	Essence of Indian Traditional Knowledge	MC	2	0	0	0	100	-	100
9	21HE4072	Career Guidance – Level IV Personality, Aptitude and Career Development	EEC	2	0	0	0	100	-	100
<b>Total</b>				<b>18</b>	<b>3</b>	<b>8</b>	<b>21</b>	<b>530</b>	<b>370</b>	<b>900</b>

**SEMESTER V**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21AU5201	Automotive Emission and Pollution Control	PC	3	0	0	3	40	60	100
2	21AU5202	Vehicle Design and Data Characteristics	PC	3	1	0	4	40	60	100
3	21AU5203	Automotive Fuels and Lubricants	PC	3	0	0	3	40	60	100
4	21AU53XX	Professional Elective – 1	PE	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
5	21AU5251	Automotive Transmission	PC	2	0	2	3	50	50	100
6	21AU5252	Automotive Chassis Components Design**	PC	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
7	21AU5001	Engine Performance and Emission Testing Lab	PC	0	0	3	1.5	60	40	100
8	21AU5002	Automotive Fuels and Lubricants Lab	PC	0	0	3	1.5	60	40	100
<b>ONE CREDIT MANDATORY COURSE</b>										
9	21HE5071	Soft Skill I	EEC	1	0	0	1	100	-	100
10	21HE5072	Design Thinking	EEC	1	0	0	1	100	-	100
<b>Total :</b>				<b>18</b>	<b>1</b>	<b>10</b>	<b>24</b>	<b>580</b>	<b>420</b>	<b>1000</b>

**SEMESTER VI**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21AU6201	Total Quality Management	HS	3	0	0	3	40	60	100
2	21AU6202	Vehicle Dynamics and Control Systems	PC	3	0	0	3	40	60	100
3	21AU6203	Finite Element Analysis	PC	3	1	0	4	40	60	100
4	21AU63XX	Professional Elective – 2	PE	3	0	0	3	40	60	100
5	21XX64XX	Open Elective - 1	OE	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
6	21AU6251	Automotive Vehicle Body and Aerodynamics	PC	2	0	3	3.5	50	50	100
<b>PRACTICAL</b>										
7	21AU6001	Finite Element Analysis Lab	PC	0	0	3	1.5	60	40	100
<b>ONE CREDIT MANDATORY COURSE</b>										
8	21AU6701	Internship Training / In plant Training	EEC	0	0	0	1	100		100
9	21HE6071	Soft Skill-II	EEC	1	0	0	1	100	-	100
10	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	-	100
<b>Total :</b>				<b>19</b>	<b>1</b>	<b>6</b>	<b>24</b>	<b>610</b>	<b>390</b>	<b>1000</b>

**SEMESTER VII**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21AU7201	Advanced Electrical and Electronics	PC	3	0	0	3	40	60	100
2	21AU7202	Engine and Vehicle Management Systems	PC	3	0	0	3	40	60	100
3	21AU73XX	Professional Elective – 3	PE	3	0	0	3	40	60	100
4	21XX74XX	Open Elective – 2	OE	3	0	0	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>										
5	21AU7251	Electric and Hybrid Vehicle\$\$	PC	2	0	2	3	50	50	100
<b>PRACTICAL</b>										
6	21AU7001	Advanced Electrical and Electronics Lab	PC	0	0	3	1.5	60	40	100
7	21AU7002	Vehicle Maintenance Laboratory	PC	0	0	3	1.5	60	40	100
<b>PROJECT</b>										
8	21AU7901	Project Work – Phase I	EEC	0	0	4	2	50	50	100
<b>Total</b>				<b>14</b>	<b>0</b>	<b>12</b>	<b>20</b>	<b>380</b>	<b>420</b>	<b>800</b>

**SEMESTER VIII**

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21AU83XX	Professional Elective – 4	PE	3	0	0	3	40	60	100
2	21AU83XX	Professional Elective – 5	PE	3	0	0	3	40	60	100
<b>PROJECT</b>										
3	21AU8901	Project Work – Phase II	EEC	0	0	16	08	100	100	200
<b>Total :</b>				<b>6</b>	<b>0</b>	<b>16</b>	<b>14</b>	<b>180</b>	<b>220</b>	<b>400</b>

**LIST OF PROFESSIONAL ELECTIVES**

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
<b>PROFESSIONAL ELECTIVE I</b>									
1	21AU5301	Alternative Fuels and Energy Systems	3	0	0	3	40	60	100
2	21AU5302	Tyre Technology	3	0	0	3	40	60	100
3	21AU5303	Automotive Materials and Manufacturing Technology	3	0	0	3	40	60	100
4	21AU5304	Battery Technology	3	0	0	3	40	60	100
5	21AU5305	Plastic Parts Manufacturing Technology	3	0	0	3	40	60	100
6	21AU5306	Composite Materials	3	0	0	3	40	60	100
<b>PROFESSIONAL ELECTIVE II</b>									
1	21AU6301	Automotive Airconditioning	3	0	0	3	40	60	100
2	21AU6302	Fuel Cell Technology	3	0	0	3	40	60	100
3	21AU6303	Ergonomics in Automotive Design	3	0	0	3	40	60	100
4	21AU6304	Additive Manufacturing	3	0	0	3	40	60	100
5	21AU6305	Robotics	3	0	0	3	40	60	100
<b>PROFESSIONAL ELECTIVE III</b>									
1	21AU7301	Automotive Vehicle Maintenance	3	0	0	3	40	60	100
2	21AU7302	Digital Supply Chain Management	3	0	0	3	40	60	100
3	21AU7303	Engine Auxiliary Systems	3	0	0	3	40	60	100
4	21AU7304	Tribology and Terotechnology	3	0	0	3	40	60	100
5	21AU7305	Entrepreneurship Development	3	0	0	3	40	60	100
6	21AU7306	Automotive Embedded Systems	3	0	0	3	40	60	100

**PROFESSIONAL ELECTIVE IV**

1	21AU8301	Digital Vehicle Monitoring	3	0	0	3	40	60	100
2	21AU8302	Computational Fluid Dynamics	3	0	0	3	40	60	100
3	21AU8303	Automotive Painting Technology	3	0	0	3	40	60	100
4	21AU8304	Non-Destructive Testing and Materials	3	0	0	3	40	60	100
5	21AU8305	Motorsports Engineering	3	0	0	3	40	60	100

**PROFESSIONAL ELECTIVE V**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU8306	Automotive Cyber Security	3	0	0	3	40	60	100
2	21AU8307	Industry 4.0	3	0	0	3	40	60	100
3	21AU8308	Autonomous Vehicle Technology	3	0	0	3	40	60	100
4	21AU8309	Off Road Vehicles	3	0	0	3	40	60	100
5	21AU8310	Unconventional Machining Processes	3	0	0	3	40	60	100
6	21AU8311	Vehicle Transport Management	3	0	0	3	40	60	100

**OPEN ELECTIVE (OE)**

1	21AU6401	Basics of Automobile Engineering	3	0	0	3	40	60	100
2	21AU7402	Automotive Safety	3	0	0	3	40	60	100

**LIFE SKILL OPEN ELECTIVES COURSES**

1	21LSX401	General Studies for Competitive Examinations	3	0	0	3	40	60	100
2	21LSX402	Human Rights, Women's Rights and Gender Equality	3	0	0	3	40	60	100
3	21LSX403	Indian Ethos and Human Values	3	0	0	3	40	60	100
4	21LSX404	Indian Constitution and Political System	3	0	0	3	40	60	100
5	21LSX405	Yoga for Human Excellence	3	0	0	3	40	60	100

**NCC OPEN ELECTIVE COURSES****(Only for the students' who have opted NCC subjects in Semester I, II, III & IV are eligible)**

1	21HEZ401	NCC course level 1	3	0	0	3	40	60	100
2	21HEZ402	NCC course level 2	3	0	0	3	40	60	100

**Minor Degree - Automotive Vehicle Technology (Offered by Automobile Engineering)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU5601	Automotive Engines	3	0	0	3	40	60	100

2	21AU6601	Automotive Chassis	3	0	0	3	40	60	100
3	21AU6602	Automotive Transmission	3	0	0	3	40	60	100
4	21AU7601	Automotive Electronics	3	0	0	3	40	60	100
5	21AU7602	Intelligent vehicular systems	3	0	0	3	40	60	100
6	21AU8601	Electric and Hybrid vehicles	3	0	0	3	40	60	100

**Minor Degree - Fintech and Block Chain (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21CS5601	Financial Management	3	0	0	3	40	60	100
2	21CS5602	Fundamentals of Investment	3	0	0	3	40	60	100
3	21CS5603	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	21CS5604	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	21CS5605	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	21CS5606	Introduction to Fintech	3	0	0	3	40	60	100

**Minor Degree - Entrepreneurship (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21BA5601	Foundation of Entrepreneurship	3	0	0	3	40	60	100
2	21BA6601	Introduction to Business Venture	3	0	0	3	40	60	100
3	21BA6602	Team Building & Leadership Management for Business	3	0	0	3	40	60	100
4	21BA7601	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100
5	21BA7602	Principles of Marketing Management for Business	3	0	0	3	40	60	100
6	21BA8601	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100

**Minor Degree - Environment and Sustainability (common to all departments)**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21CEXXXX	Sustainable infrastructure Development	3	0	0	3	40	60	100
2	21CEXXXX	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
3	21CEXXXX	Sustainable Bio Materials	3	0	0	3	40	60	100
4	21CEXXXX	Materials for Energy Sustainability	3	0	0	3	40	60	100

5	21CEXXXX	Green Technology	3	0	0	3	40	60	100
6	21CEXXXX	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100

**Honors Degree - Electric and hybrid vehicle development**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU5204	Fundamentals of Electric and Hybrid Vehicles	3	0	0	3	40	60	100
2	21AU6204	Battery Technology	3	0	0	3	40	60	100
3	21AU6205	Automotive Embedded Systems	3	0	0	3	40	60	100
4	21AU7203	Advanced Automotive Safety Systems	3	0	0	3	40	60	100
5	21AU7204	Electric Vehicle Technology	3	0	0	3	40	60	100
6	21AU8201	Energy Storage Techniques for Electric Vehicles.	3	0	0	3	40	60	100

**Honors Degree - Motorsport Engineering**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU5205	Composite Structure	3	0	0	3	40	60	100
2	21AU6206	High performance engine design	3	0	0	3	40	60	100
3	21AU6207	Motorsports Electric Vehicle	3	0	0	3	40	60	100
4	21AU7205	Motorsports Vehicle Body Engineering	3	0	0	3	40	60	100
5	21AU7206	Motorsports Race Electronics and Control Systems	3	0	0	3	40	60	100
6	21AU8202	Motorsports racing circuits and Design	3	0	0	3	40	60	100

**Honors Degree - Vehicle Development and Validation**

S.No	Course Code	Course Name	L	T	P	C	CIA	ESE	TOTAL
1	21AU5206	Automotive Product Design and Development	3	0	0	3	40	60	100
2	21AU6208	Noise, Vibration and Harshness	3	0	0	3	40	60	100
3	21AU6209	Automotive Instrumentation	3	0	0	3	40	60	100
4	21AU7207	Testing and Measurement Systems	3	0	0	3	40	60	100
5	21AU7208	Homologation	3	0	0	3	40	60	100
6	21AU8203	Automotive Prototyping	3	0	0	3	40	60	100

**CREDIT DISTRIBUTION**

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	26	24	18	14	165


\* Student can earn extra credit 35 over and above the total credits

ADDITIONAL CREDIT COURSE FOR NCC CADETS											
S.No	Course code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL	
1	21HE1074	NCC General and National Integration	VA	1	0	0	1	100	0	100	
2	21HE2074	Social Services and Community Development	VA	1	0	0	1	100	0	100	
3	21HE3074	Leadership Qualities and Camp Activities	VA	1	0	0	1	100	0	100	
4	21HE4074	General awareness, communication and Aero engines	VA	1	0	0	1	100	0	100	

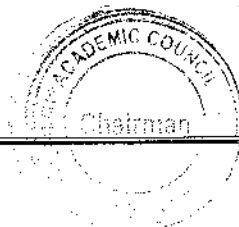
ADDITIONAL CREDIT COURSE FOR AUTOMOBILE ENGINEERING						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1	21VAAU01	Foundry Technology	VA	30 hrs	Internal	1
2	21VAAU02	Forming and Shaping of Plastics	VA	30 hrs	Internal	1
3	21VAAU03	Microcontroller Programming in Automotive applications	VA	30 hrs	Internal	1
4	21VAAU04	Vehicle development and testing regulations (ARAI)	VA	30 hrs	Internal	1
5	21VAAU05	Bigdata Analysis	VA	30 hrs	Internal	1
6	21VAAU06	Data mining	VA	30 hrs	Internal	1
7	21VAAU07	Fire and safety Engineering	VA	30 hrs	Internal	1
8	21VAAU08	Introduction to MS office	VA	30 hrs	Internal	1
9.	21VAAU09	Autodesk Fusion 360	VA	30 hrs	Internal	1

Note: Non Credit Course results will not consider for Award of Degree

  
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 Principal





**Course Objectives**

1. To practice acquired knowledge within the chosen area of technology for project development.
2. To Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
3. To Reproduce, improve and refine technical aspects for engineering projects.
4. To Work as an individual or in a team in development of technical projects.
5. To Communicate and report effectively project related activities and findings

The student 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 COE / Head of the Department.

**Course Outcomes**

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

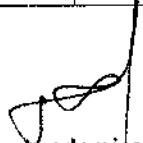
- CO1: Practice acquired knowledge within the chosen area of technology for project development.
- CO2: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
- CO3: Reproduce, improve and refine technical aspects for engineering projects.
- CO4: Work as an individual or in a team in development of technical projects.
- CO5: Communicate and report effectively project related activities and findings

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	2	2	2	3	3	3	3	3	3	3
CO2	3	1	2	1	2	2	2	3	2	2	3	3	2	2
CO3	2	3	3	2	2	2	2	2	3	3	2	2	3	3
CO4	3	3	3	3	2	2	2	3	3	3	3	3	3	3
CO5	3	1	2	1	2	2	2	3	2	2	3	3	2	2
AVG	2.8	2.2	2.6	2	2	2	2	2.8	2.6	2.6	2.8	2.8	2.6	2.6

  
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**Course Objectives**

1. To learn about the automotive sensors and its utility in Automotive data acquisition systems
2. To acquire the knowledge on Digital Twin Technology and its applications.
3. To get a widespread knowledge on AR/VR based inspection processes.
4. To understand the concept of connected car technology.
5. To get exposure in automotive infotainment.

**UNIT I AUTOMOTIVE SENSORS****(9)**

Introduction to automotive sensors – resistive, inductive, capacitive transducers, Piezo electric transducers, Hall effect sensors, Ultrasonic sensors, Ranging radar (ACC) Power Train: - Fuel level sensors, Speed and RPM sensors, Lambda Oxygen sensor, NOX sensors, Hotwire air mass meter Chassis: - Steering wheel angle sensor, Vibration and acceleration sensors, Pressure sensors, Speed and RPM sensors, torque sensors.

**UNIT II DIGITAL TWIN TECHNOLOGY****(9)**

Introduction to Digital twin – Digital Twin and IoT – Digital twin vs Predictive twins – Benefits – Relationships among digital twins in a system – digital twin in entity lifecycle – technical aspects of digital twin – standards and framework – Case studies

**UNIT III AR/VR BASED INSPECTION PROCESS****(9)**

History and differences between Augmented and Virtual Reality - Basics of Computer Vision and Multimodal Interaction - AR systems for Fault Inspection - Head Up and Head Mounted Systems in Automotive Domain - Virtual Reality System development in Unity - Rendering real time sensor data in VR model - Human Robot Interaction using AR/VR systems

**UNIT IV ADVANCED TECHNOLOGY IN CONNECTIVITY****(9)**

Connected car technology – features: internet connectivity in cars, App to car connectivity, geofencing, vehicle to vehicle communication, Entertainment, remote parking and security – 5G and connected car tech – Types of connectivity: Vehicle to Infrastructure (V2I), Vehicle to Vehicle (V2V), Vehicle to Cloud (V2C), Vehicle to Pedestrian (V2P), Vehicle to Everything (V2X) – case studies in vehicle maintenance and motorsports.

**UNIT V INFOTAINMENT SYSTEM****(9)**

Infotainment electronics Dashboard instrument cluster, car audio, telematics systems, navigation systems, multimedia systems - Onboard diagnostics, fault code displays - engine data display - Global positioning systems, geographical information stems, navigation systems, automotive vision system, road recognition, driver assistance systems

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Learn about the automotive sensors and its utility in Automotive data acquisition systems  
 CO2: Acquire the knowledge on Digital Twin Technology and its applications.  
 CO3: Acquire widespread knowledge on AR/VR based inspection processes.  
 CO4: Understand the concept of connected car technology.  
 CO5: Acquire exposure in automotive infotainment.

**Text Books**

- T1 William R Sherman and Alan B Craig. "Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002  
 T2 Alan B. Craig. Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013  
 T3 Grigore C. Burdea, Philippe Coiffet . Virtual Reality Technology, Wiley 2016

**References**

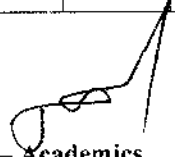
- R1 Dieter Schmalstieg and Tobias Höllerer, Augmented Reality: Principles & Practice, Pearson Education India, 2016
- R2 Kent Norman (Ed), Wiley Handbook of Human Computer Interaction, Wiley 2017
- R3 Andy Field, "Discovering Statistics Using SPSS", SAGE Publications Ltd., 2009

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
CO2	1	2	-	2	2	3	3	-	-	3	-	2	2	3
CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To study the basic governing equations and understand the basic properties of CFD.
2. To understand discretization techniques and solving methods for improving accuracy.
3. To understand Steady And Unsteady Diffusion, Advection-Diffusion Problems
4. To understand the significance of turbulence models and mesh generation.
5. To inculcate the knowledge required to solve real time physical problems using simulation software.

**UNIT I CLASSIFICATION OF PDES, GOVERNING EQUATIONS (9)**

Introduction to Computational Fluid Dynamics and Principles of Conservation: Continuity Equation, Navier Stokes Equation, Energy Equation and General Structure of Conservation Equations, Classification of Partial Differential Equations and Physical Behaviour.

**UNIT II PRINCIPLES OF COMPUTATIONAL METHODS (9)**

Fundamentals of Discretization: Finite Element Method, Finite Difference and Finite Volume Method, Consistency, Stability and Convergence. 1-D Steady State Diffusion Problems- Source term linearization, Implementation of boundary conditions

**UNIT III STEADY AND UNSTEADY DIFFUSION, ADVECTION-DIFFUSION PROBLEMS (9)**

Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, and Finite volume discretization of two-dimensional convection-diffusion problem.

**UNIT IV ALGORITHMS AND VARIOUS DISCRETIZATION SCHEMES. (9)**

Finite Volume Discretization of 2-D unsteady State Diffusion type Problems, Solution of Systems of Linear Algebraic Equations: Elimination Methods, Iterative Methods Discretization of Navier Stokes Equations, primitive variable approach.

**UNIT V ENGINEERING PROBLEMS USING CFD SOFTWARE (9)**

Introduction to Turbulence Modeling, Important features of turbulent flow, General Properties of turbulent quantities, Reynolds average Navier stokes (RANS) equation, Closure problem in turbulence: Necessity of turbulence modeling and applications.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the classification of PDEs, governing equations
- CO2: Understand the basic principles of computational methods
- CO3: Apply finite volume method to solve steady and unsteady diffusion, advection-diffusion problems
- CO4: Understand Solution algorithms and various discretization schemes.
- CO5: Solve engineering problems using CFD software

**Text Books**

- T1 John D. Anderson "Computational Fluid Dynamics the Basics with Applications", Tata McGraw Hill Publishing Company Ltd., 20
- T2 Ghoshdastidar. P.S., & quot;Computer Simulation of flow and heat transfer & quot;. Tata McGraw Hill Publishing Company Ltd., 2017.

**References**

- R1 Muralidhar, K., and Sundararajan, T., & quot; Computational Fluid Flow and Heat Transfer & quot;; Narosa Publishing House, New Delhi, 2014.

R2 Patankar, S.V. & quot; Numerical Heat Transfer and Fluid Flow & quot; Hemisphere Publishing Corporation,2004.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	3	1	-	1	-	1	2	1	3	2
CO2	3	2	2	3	2	1	2	1	1	2	3	1	3	2
CO3	3	3	3	3	3	2	1	1	1	1	3	1	3	2
CO4	3	3	3	3	3	1	-	-	1	-	3	2	3	2
CO5	2	2	2	2	1	-	2	1	-	1	2	1	2	1
AVG	2.8	2.4	2.4	2.8	2.5	1.2	1.4	1	1	1.2	2.6	1.2	2.8	2.4

  
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**Course Objectives**

1. To understand the basic concepts about paints, their ingredients, functions of various ingredients and classification of paints.
2. To understand composition and properties of various ingredients.
3. To understand about surface preparation and application of paints on various surfaces.
4. To understand the Modern Automotive Coating Processes.
5. To understand the Automotive Coating Performance.

**UNIT I BASICS ASPECTS AND CONCEPTS****(9)**

Paint definition, paints and their general ingredients, functions of ingredients, classifications of paints, drying / curing mechanism of paints.

**UNIT II PAINTS AND COATINGS RAW MATERIALS****(9)**

Drying oils, modified drying oils, natural resins, synthetic resins, extenders & prime pigments, inorganic & organic pigments, lakes & toners, dyes & pigments, true solvents, latent solvents & diluents, properties of solvents, drying catalysts (driers), plasticizers, additives for solvent-borne & water-borne paints

**UNIT III SURFACE PREPARATION****(9)**

Different steps involved in preparation of painting process, paint removal – sand blasting, hot caustic solution, paint remover, power sanding equipment, spray gun, types, common paint defects and their prevention & cure.

**UNIT IV MODERN AUTOMOTIVE COATING PROCESSES****(9)**

Pretreatment, electrodeposition (ED), underbody coating (UBC) and seam sealing PVC (Polyvinyl Chloride), primer, smoother, topcoats, basecoat, clearcoat, spray coating.

**UNIT V AUTOMOTIVE COATING PERFORMANCE****(9)**

Coating Quality, Gloss and Smoothness of Paint Material, Colour, Corrosion Protection, Trends in Automotive Coating Processes- Powder Coating, 3-Wet Paint.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the basic concepts about paints, their ingredients, and functions of ingredients and classification of paints.
- CO2: Understand the composition and properties of various raw materials for paints.
- CO3: Prepare and paint various types of substrates.
- CO4: Learn the Modern Automotive Coating Processes.
- CO5: Test the automotive paints coating performance and their raw materials.

**Text Books**

- T1 V.C. Malshe, "Basics of Paint Technology (Part I & II)", Prakash C. Malshe, 2008
- T2 Nelson K. Akafuah and Sadegh Poozes "Evolution of the Automotive Body Coating Process." 2016

**References**


- R1 Hans-Joachim Streitberger and Karl-Friedrich Dossel, "Automotive Paints and Coatings" John Wiley & Sons, 2008.
- R2 A Monozukuri-Hitozukuri Perspective, "Automotive Painting Technology", Springer Dordrecht Heidelberg London New York, 2013

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
CO2	1	2	-	2	2	3	3	-	-	3	-	2	2	3
CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To study and understand the various Non-Destructive Evaluation and Testing methods, theory and their industrial applications.
2. To provide a basic understanding on different surface NDE techniques and apply them for inspecting materials in accordance with industry specifications and standards
3. To understand principles and techniques of thermography and eddy current testing
4. To provide a sound theoretical knowledge and practical skill for Ultrasonic testing
5. To get familiarized with codes, standards and specifications for RT with respect to safety norms

**UNIT I INTRODUCTION TO NDT**

(7)

NDT Versus Mechanical testing--Overview of NDT Methods for the detection of manufacturing defects as well as material characterisation--merits and limitations--Various physical characteristics of materials and their applications in NDT--Visual inspection - Unaided and aided

**UNIT II SURFACE NDE METHODS**

(8)

Liquid Penetrant Test-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 (ET)**

(10)

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 (UT) AND ACOUSTIC EMISSION (AE)**

(10)

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 (RT)**

(10)

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****Course Outcomes**

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

- CO1: Infer knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures
- CO2: Differentiate various defect types and select the appropriate NDT methods for better evaluation.
- CO3: Identify equipment required for the testing process
- CO4: Ability to communicate their conclusions clearly to specialist and non-specialist audiences.
- CO5: Documentation of the testing and evaluation of the results for further analysis.

**Text Books**

- T1 Baldev Raj, T.Jayakumar and M.Thavasimuthu "Practical Non-Destructive Testing". Narosa Publishing, 2009.
- T2 Ravi Prakash, "Non-Destructive Testing Techniques". 1st revised edition, New Age Publishers, 2010

**References**

- R1 Paul E Mix. "Introduction to Non-destructive testing: a training guide". Wiley New Jersey. 2005
- R2 Charles, J. Hellier, "Handbook of Nondestructive evaluation", McGraw Hill, New York 2001

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
CO2	1	2	-	2	2	3	3	-	-	3	-	2	2	3
CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To understand the aerodynamic performance of racing vehicles.
2. To remember the essential types of engines and components used in racing vehicles.
3. To understand the sports vehicle chassis construction and suspension systems.
4. To understand the constructional outline of sports vehicles.
5. To remember and recall the various terms used in motor sporting events.

**UNIT I RACE VEHICLE AERODYNAMICS**

(9)

Introduction – Aerodynamic vehicle shape – Impact – down-force performance – creating and measuring aerodynamic forces – type of air foil shapes – tyre performance – race vehicle dynamics – Effect of Aerodynamics.

**UNIT II RACE VEHICLE ENGINE TECHNOLOGY**

(9)

Introduction to modern engine technologies - Lean Burn Engines, Stratified Charged Engines, Low heat Rejection Engines, Homogeneously Charged Compression Ignition Engines – Engine Tuning – Race vehicle gear box – gear shift array.

**UNIT III SPORTS VEHICLE CHASSIS AND SUSPENSION**

(9)

Chassis – Purpose – history – types – Ladder frame – Multi tubular – space frames – unitary Construction – safety regulations - Suspension – Trailing link – Wishbones – Sturt type – Swing axle – Sliding Pillar – live axle – De Dion.

**UNIT IV SPORTS VEHICLE LAYOUT**

(9)

Front – rear suspension – Mounting Brackets – Methods of mounting suspension – Engine and Transmission Mounting – Steering layout and mechanism – Body Mounting – Exhaust pipe mounting – Brakes – Radiators – Oil Coolers – Electrical Wiring – Seats.

**UNIT V RACING TERMINOLOGY**

(9)

Circuit general rule – Case Study: Kari Motor, Buddha & Madras Motor Race Circuit Layout – Flag – types – description – Race officials designation and roles – Importance of driver safety gears - Racing ethics.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Understand the aerodynamic characteristics of the motor sporting vehicles.  
 CO2: Remember the working of various racing vehicle engines and performance tune ups.  
 CO3: Understand the chassis integration and suspension performance of racing vehicles.  
 CO4: Understand the components mounting methods in sports vehicles.  
 CO5: Remember the necessary terms frequently used in motor sporting along with case studies.

**Text Books**

- T1 Derek Seward, "Race Car Design". Red Globe Press, 2014.  
 T2 Andrew Livesey, "Basic Motorsport Engineering", A Butterworth-Heinemann Title, 2011.

**References**

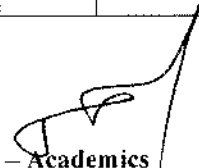
- R1 V.A.W.Hiller and Calex Ltd. "Hillier's Fundamentals of Motor Vehicle Technology" OUP Oxford, 2012.  
 R2 Michael Costin and David Phipps. "Racing and Sports Car Chassis Design", Robert Bentley, 1975.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
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CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To infer about cyber security and its consequences.
2. To get knowledge in cyber vulnerabilities and security
3. To know about cybersecurity strategies.
4. To gain the importance of cybersecurity and embedded systems
5. To get aware of best practices for modern vehicles.

**UNIT I INTRODUCTION TO CYBER SECURITY (9)**

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats: - Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage, need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

**UNIT II CYBER SECURITY VULNERABILITIES AND CYBER SECURITY SAFEGUARDS (9)**

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

**UNIT III AUTOMOTIVE CYBERSECURITY STRATEGIES (9)**

Strategies to build in security by design processes - ISO 21434 implementation - Embedded systems security developments, - Intrusion and threat detection strategies - Secured product engineering - Autonomous Vehicle Software - Automotive digital assets protection - Automotive Safety, Security, Privacy, and Reliability - Vectors of Automotive Cyber Protection - Internet of Things (IoT) – Robotics - Self-driving Cars - Next Gen Computing – Blockchain - Artificial Intelligence (AI) and Machine Learning (ML) - Quantum Technologies - Computer Vision

**UNIT IV CYBERSECURITY AND EMBEDDED SYSTEMS (9)**

Architecture for embedded systems - Patterns and real-time constraints - Automotive Embedded software testing and validation - Practical ways and techniques to test for safety requirements - How to develop and test safety requirements - Automotive On-board tamper-prevention and evidence - Automotive Embedded systems safeguarding and exploitation - Cyber-physical attacks and countermeasures - Big data and cloud data security in Automotive and V2X ecosystems

**UNIT V CYBERSECURITY BEST PRACTICES FOR MODERN VEHICLES (9)**

Segmentation and Isolation Techniques in Vehicle Architecture Design - Control Internal Vehicle Communications - Log Events - Control Communication to Back-End Servers - Control Wireless Interfaces – Serviceability - Secure Coding - Static and Dynamic Code Analysis – Case studies.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Infer about cyber security and its consequences.  
 CO2: Explain knowledge in cyber vulnerabilities and security  
 CO3: Elaborate about cybersecurity strategies.  
 CO4: Enumerate the importance of cybersecurity and embedded systems  
 CO5: Implement the best practices for modern vehicles.

**Text Books**

- T1 Möller, Dietmar P.F., Haas, Roland E, 'Guide to Automotive Connectivity and Cybersecurity Trends, Technologies, Innovations and Applications', Springerlink, 2019.  
 T2 Craig Gibbs, Automotive Cybersecurity: Issues and Vulnerabilities, Nova publishers, 2016.  
 T3 Kim, Shiho, Shrestha, Rakesh, 'Automotive Cyber Security Introduction, Challenges, and Standardization', Springer, 2020.

**References**

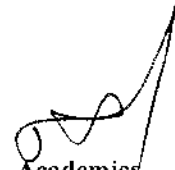
- R1 Dr. Yasir Imtiaz Khan. Automotive Cyber Security Challenges: A Beginner's guide., 2020.  
 R2 Lemke, Kerstin, Paar, Christof, Wolf, Marko, Embedded Security in Cars Securing Current and Future Automotive IT Applications, Springer, 2006.

CO PO MAPPING

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CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
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AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To understand the developments and challenges of industry 4.0
2. To understand the road map for the industry 4.0
3. To learn the various technologies transforming industrial production
4. To gain knowledge about industry 4.0 opportunities for sustainability.
5. To understand different models and frame works for Industry 4.0 through case studies.

**UNIT I INTRODUCTION**

(9)

Various Industrial Revolutions-Digitalisation and the Networked Economy-Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0-The Journey so far: Developments in USA, Europe, China and other countries-Comparison of Industry 4.0 Factory and Today's Factory-Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

**UNIT II ROAD TO INDUSTRY 4.0**

(9)

Introduction to modern engine technologies - Lean Burn Engines, Stratified Charged Engines, Low heat Rejection Engines, Homogeneously Charged Compression Ignition Engines – Engine Tuning – Race vehicle gear box – gear shift array.

**UNIT III TECHNOLOGIES FOR ENABLING INDUSTRY 4.0**

(9)

Big Data Analytics-Simulation -Robotic Automation and Collaborative Robots-Horizontal and Vertical System Integration-- Cloud Computing-Cyber Security-Augmented Reality-Implementation patterns in manufacturing companies

**UNIT IV INDUSTRY 4.0 OPPORTUNITIES FOR SUSTAINABILITY**

(9)

Sustainable Industry 4.0 Framework-Current Trends and Future Perspectives-Contribution of Industry 4.0 Technologies for Industrial Performance-Smart manufacturing standardization- Architectures, reference models and standards framework- Barriers to the adoption of industry 4.0 technologies in the manufacturing sector

**UNIT V INDUSTRY 4.0 -CASE STUDIES**

(9)

IOT-enabled smart appliances under industry 4.0-Smart factory performance and Industry 4.0-Leveraging industry 4.0 – A business model pattern framework-Current research and future perspectives on human factors and ergonomics in Industry 4.0- Cybersecurity in the context of industry 4.0: A structured classification of critical assets and business impacts.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Implement the big data and digitization concepts in the development of industrial economy  
 CO2: Describe the development in improvising the societal needs through internet and logistics  
 CO3: Generate low cost products by implementing various technologies.  
 CO4: Create opportunities in the manufacturing sector with innovative ideas.  
 CO5: Provide solutions for the problems that are raised through industry 4.0.

**Text Books**

- T1 Ustundag, Alp, Cevikcan, Emre. Industry 4.0: Managing The Digital Transformation, 2018  
 T2 Popkova, Elena G., Ragulina, Julia V., Bogoviz, Aleksei V. Industry 4.0: Industrial Revolution of the 21st Century, 2019

**References**

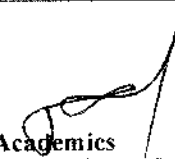
- R1 V.A.W.Hillier and Calex Ltd, "Hillier's Fundamentals of Motor Vehicle Technology" OUP Oxford, 2012.  
 R2 Michael Costin and David Phipps, "Racing and Sports Car Chassis Design", Robert Bentley, 1975.

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CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
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AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To get good exposure an autonomous vehicle technology
2. To understand the autonomous vehicle concepts.
3. To acquire knowledge in advance systems.
4. To familiarize the concept of automated mechanism.
5. To recognize the various adjustment systems for comfort and convenience drive.

**UNIT I INTRODUCTION**

(9)

Autonomous driving-man and machine-automated driving in its social, historical and cultural contexts-autonomous driving technologies.

**UNIT II PREPARATION IN AUTONOMOUS DRIVING**

(9)

Introduction-data sets-object detection- segmentation-stereo, optical flow, scene flow, tracking- convolution neural networks-semantic segmentation.

**UNIT III DECISION,PLANNING AND CONTROL**

(9)

Vehicle model, road model and SL coordinate system, motion planning path planning ,speed planning, longitudinal planning-legal planning-control- bicycle control-PID control.

**UNIT IV MOBILITY**

(9)

Autonomous driving from an innovation policy perspective - visions of autonomous driving in europe- competitiveness and innovation- efficiency and sustainability- harmonization and coordination.

**UNIT V SAFETY AND SECURITY**

(9)

Predicting of machine perception for automated driving- predicting of machine perception for automated driving- the release of autonomous vehicles- safety concept for autonomous vehicles- collecting and making usable additional data- product liability issues in the risk management.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Acquire knowledge in autonomous vehicle importance.  
 CO2: Able to analyze the autonomous concepts.  
 CO3: Illustrate the various autonomous vehicle equipments functions and importance.  
 CO4: Acquire knowledge on various autonomous vehicle test.  
 CO5: Able to know the function of safety and security systems.

**Text Books**

- T1 Ronald.K.Jurgen, "Autonomous Handbook", Second Edition, McGraw-Hill Inc., 1999.  
 T2 Creating Autonomous Vehicle Systems (Kindle Edition)by Shaoshan Liu, Liyun Li.

**References**

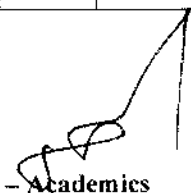
- R1 Ronald.K.Jurgen. "Autonomous systems". Second Edition, McGraw-Hill Inc., 1999.  
 R2 George A. Peters, Barbara J. Peters, - Vehicle technology – 2002.

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CO3	1	2	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To understand the various off road vehicle, earth moving machine, construction machine and equipments
2. To impart knowledge in off road vehicle special equipments
3. To understand the design concepts of off road vehicle special equipments
4. To impart the knowledge of handling off road vehicles and equipments
5. To learn about off road vehicle systems and features

**UNIT I CLASSIFICATION AND REQUIREMENTS OF OFF ROAD VEHICLES (9)**  
Off road vehicles-Construction layout-capacity-applications-Power Plants-Chassis and Transmission-Multi axle vehicles.

**UNIT II EARTH MOVING MACHINES (9)**  
Earthmovers-dumpers-loaders-single bucket-Multi bucket-rotary types-bulldozers-excavators-backhoe loaders-scrappers-drag and self powered types-Bush cutters-stumpers-tree dozer-rippers etc-crawler tracks mounted / wheeled-bull dozers-tilt dozers and angle dozers-front end loaders- factors affecting efficiency output of tractors-and demerits.

**UNIT III SCRAPPERS ,GRADERS, SHOVELS AND DITCHERS (9)**  
Scrappers-elevating graders-motor graders-self powered scrappers and graders-Power shovel-revolving and stripper shovels-drag lines-ditchers-capacity of shovels.

**UNIT IV FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES (9)**  
Earth moving machines-Power and capacity-General description-specification-functions-light- medium and heavy wheeled tractors-Power take off-special implements-Special features and constructional details of tankers-gun-carriers and transport vehicles.

**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 bulldozer operational linkages- dumper-Safety features-safe warning system-Design aspects-loader bucket-dumper and water tank of sprinkler.

**TOTAL: 45 PERIODS**

**Course Outcomes**

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

- CO1: Understand the off road vehicles based on the need and purpose.  
CO2: Learn about off road vehicle special equipments.  
CO3: Develop the design concepts of off road vehicle special equipments.  
CO4: Handle the off road vehicle and its special equipments.  
CO5: Familiar in off road vehicle system and features.

**Text Books**

- T1 Robert L Peurifoy, "Construction, planning, equipment and methods" Tata McGraw Hill, 2009.  
T2 Nakra C.P., "Farm machines and equipments" Dhanparai Publishing company Pvt. Ltd.  
T3 Abrosimov.K, Bran berg.A and Katayer.K., "Road making machinery", MIR Publishers, Moscow, 1971.  
T4 SAE Handbook Vol. III., Society of Automotive Engineers, 1997  
T5 Wong.J.F., "Theory of Ground Vehicles", John Wiley & Sons, New York, 1987.

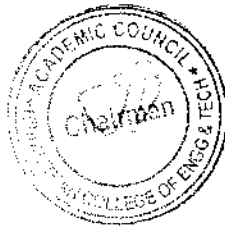
**References**


- R1 Ia. S. Ageikin, "Off the Road Wheeled and Combined Traction Devices: Theory and Calculation", Ashgate Publishing Co. Ltd. 1988.

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AVG	1.4	2.4	2	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To learn about various unconventional machining processes
2. To learn machining processes that use different energies
3. To understand the principle, mechanism of metal removal of various unconventional machining processes.
4. To study the various process parameters and their effect on the component machined on various unconventional machining processes.
5. To understand the applications of different processes

**UNIT 01 INTRODUCTION****(8)**

Unconventional machining Process – Need – classification – Brief overview.

**UNIT 02 MECHANICAL ENERGY BASED PROCESSES****(9)**

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

**UNIT 03 ELECTRICAL ENERGY BASED PROCESSES****(9)**

Electric Discharge Machining (EDM)–working Principle–Equipment’s–Process Parameters–Surface Finish and MRR– Electrode / Tool – Power and control Circuits–Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

**UNIT 04 CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES****(10)**

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

**UNIT 05 THERMAL ENERGY BASED PROCESSES****(9)**

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

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Able to differentiate the machining processes that use different energies  
 CO2: Able to identify the process parameters, their effect and applications of different processes.  
 CO3: Select the best machining process for different materials to be processed  
 CO4: Apply and analyze the manufacturing processes to reduce the cost of the product  
 CO5: Solve problems related to tools, equipment and processes used in the industry

**Text Books**

- T1 Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007  
 T2 Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007

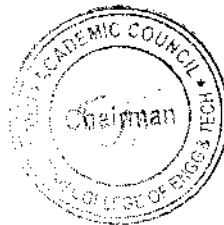
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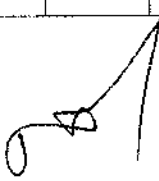
- R1 Benedict. G.F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987.  
 R2 McGeough. “Advanced Methods of Machining”, Chapman and Hall, London, 1998.

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**Course Objectives**

1. To understand managerial activities related to transport system.
2. To know about features of scheduling, fixing the fares for passenger transport operations.
3. To discuss about the various aspects of goods transport operations.
4. To learn the various scheduled and unscheduled maintenance procedures.
5. To get an exposure about the motor vehicle act and maintenance aspects of transport.

**UNIT I INTRODUCTION**

(9)

Personnel management - objectives – functions – psychology - sociology with relevance to organization – personality problems - Selection process - job description - employment tests - interviewing – training – objectives – advantages - methods – procedure - psychological tests.

**UNIT II PASSENGER TRANSPORT OPERATION**

(9)

Passenger transport organizations - depot layouts - requirements and problems on fleet management – fleet maintenance - planning - scheduling operation and control - personnel training - training for drivers and conductors - public relations – propaganda - publicity and passenger amenities - parcel traffic - theory of fares - fare charging - economics and records.

**UNIT III GOODS TRANSPORT OPERATION**

(9)

Structure of goods transport organizations - scheduling of goods transport - management information System (MIS) in passenger and goods transport operation - storage and transportation of petroleum products – advanced techniques in Traffic Management - Traffic navigation - Global positioning system (GPS).

**UNIT IV MAINTENANCE**

(9)

Scheduled and unscheduled maintenance - preventive maintenance system - tyre maintenance - causes for uneven tyre wear – remedies - maintenance procedure for better fuel economy -breakdown analysis - control of repair backlogs.

**UNIT V MOTOR VEHICLE ACT**

(9)

Registration of motor vehicles – licensing of drivers - Conductor's license – control of permits – Taxation – Insurance - Legal compliance - Policies of transport organization - Importance of warranty system and protection of law - Buying a new vehicle: Factors to be considered – Scrapping policies - limits of speed – traffic signs – constructional regulations – description of goods carrier - delivery van – tanker – tipper – municipal - firefighting and break down service vehicle – Various Research Organizations – CRRI, PCRA, CIRT, ARAI, VRDE.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Manage a transport fleet and their related activities with improved managerial skills.  
 CO2: Maintain the services with good relationship, good behavior and trustworthiness.  
 CO3: Improve the efficiency of goods transport with minimal operational cost.  
 CO4: Perform maintenance activities in time to avoid unnecessary downtime.  
 CO5: Know about the various transport laws and motor vehicle acts.

**Text Books**

- T1 John Duke - Fleet Management – McGraw-Hill Co, USA -1984.  
 T2 Government Motor Vehicle Act – Eastern Book Company, Lucknow – 1989.

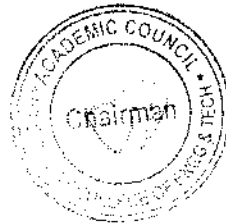
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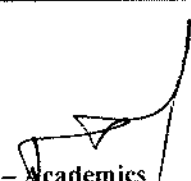
- R1 Kitchin.L.D., - Bus Operation - Illiffie and Sons Co., London, III edition – 1992  
 R2 The motor vehicle Act 1939 – EjazAhemad, Ashok law house, India - 1989.

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**Course Objectives**

1. To comprehend general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub system design and hybrid vehicle control.
2. To Understand about vehicle dynamics
3. To Design the required energy storage devices
4. To Select the suitable electric propulsion systems
5. To Understand of hybrid electric vehicles

**UNIT I INTRODUCTION**

(9)

Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Advantages and Limitations of hybrid and electric Vehicles.

**UNIT II DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES**

(9)

Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency-Electric Vehicle Recharging and Refueling Systems.

**UNIT III BATTERY**

(9)

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

**UNIT IV DC & AC ELECTRICAL MACHINES**

(9)

Motor and Engine, rating, Requirements, DC machines, Three phase A/c machines, Induction machines, Permanent magnet machines, switched reluctance machines.

**UNIT V ENERGY MANAGEMENT SYSTEMS**

(9)

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Summarize the electric and hybrid vehicle operation and architectures
- CO2: Design and develop the systems of hybrid and electric vehicles
- CO3: Demonstrate the energy requirement for vehicles
- CO4: Model and simulate the vehicle characteristics, operating modes, and performance parameters of the vehicle
- CO5: Explain the different subsystems of hybrid and electric vehicles

**Text Books**

- T1 Iqbal Husain, "Electric and Hybrid Vehicles-Design Fundamentals". CRC Press, 2003
- T2 Mehrdad Ehsani, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press, 2005.

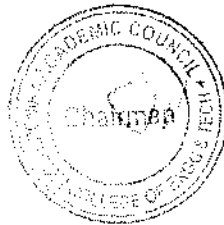
**References**

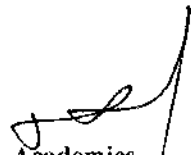
- R1 Sandeep Dhameja, "Electric Vehicle Battery Systems" NEWNES, 2002
- R2 James Larminie and John Lowry, "Electric Vehicle Technology Explained" John Wiley & Sons, 2003
- R3 Ron Hodkinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication, 2005

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2		3	2	2		2		3	1	2
CO2	3	3	3	2		3	2	1		2		3	1	2
CO3	3	3	3	2		3	2	1		2		3	1	2
CO4	3	3	3	2		3	2	1		2		3	1	2
CO5	3	3	3	2		3	2	1		2		3	1	2
AVG	3	3	3	2		3	2	1.2		2		3	1	2

  
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21AU8201

**ENERGY STORAGE TECHNIQUES FOR ELECTRIC VEHICLE**

L	T	P	C
3	0	0	3

**Course Objectives**

1. To understand working of different types of electric vehicles.
2. To explain the battery parameters.
3. To understand different types of batteries.
4. To illustrate battery charging and modelling
5. To introduce novel and alternate energy sources

**UNIT I TYPES OF ELECTRIC VEHICLE**

(9)

Battery electric vehicles, The IC engine/electric hybrid vehicle, fuelled electric vehicles, Electric vehicles using supply lines, Solar powered vehicles, Electric vehicles which use flywheels or super capacitors, Electric Vehicles for the Future.

**UNIT II BATTERY PARAMETERS**

(9)

Electrochemical Batteries, Cell and battery voltages, Charge (or Amp hour) capacity, Energy stored, Specific energy, Energy density, Specific power, Amp hour (or charge) efficiency, Energy efficiency, Self-discharge rates, Battery geometry, Battery temperature, Battery life and number of deep cycles.

**UNIT III TYPES OF BATTERIES**

(8)

Lead Acid Batteries, Nickel-based Batteries: Introduction, Nickel cadmium, Nickel metal hydride batteries, Sodium-based Batteries, Lithium Batteries, Metal Air Batteries.

**UNIT IV BATTERY CHARGING AND MODELLING**

(10)

Battery Charging, Battery chargers, Charge equalization, The Designer's Choice of Battery, Use of Batteries in Hybrid Vehicles, Internal combustion/battery electric hybrids, Battery/battery electric hybrids, Combinations using flywheels, Complex hybrids, Battery Modelling, the purpose of battery modelling, Battery equivalent circuit, Modelling battery capacity, Simulation a battery at a set power, Calculating the Peukert Coefficient, Approximate battery sizing.

**UNIT V ALTERNATIVE AND NOVEL ENERGY SOURCES AND STORES**

(9)

Introduction, Solar Photovoltaic, Wind Power, Flywheels, Ultra capacitors, Super Capacitors, Supply Rails, Hydrogen Fuel Cells: Basic Principles, Hydrogen Storage I: Storage as Hydrogen, Hydrogen Storage II: Chemical Methods.

**TOTAL: 45 PERIODS**

**Course Outcomes**

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

- CO1: Identify various types of electric vehicles and their performance parameters
- CO2: Analyze the battery parameters and their variations during charge and discharge cycles
- CO3: List different types of batteries and analyse their performance parameters
- CO4: Examine the battery charging requirements and develop the complete battery model
- CO5: Identify novel and alternate energy sources which could be used in EVs

**Text Books**

- T1 James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., UK. Electric Vehicle Technology Explained, 2003
- T2 Alfred Rufer, "Energy Storage systems and components", CRC Press, 2017
- T3 Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2021

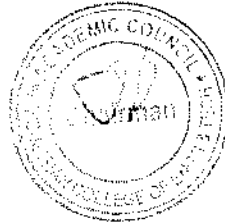
**References**

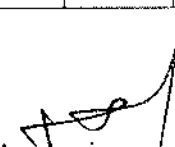
- R1 Mehard Ehsani, Yiming Gao, Stefano Iongo and Kambiz Ebrahimi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", CRC Press, 3rd Edition.

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	1	2			3	2				3	3	2	3
CO2	3	1	2			3	2				3	3	2	3
CO3	3	2	2	2		3	3				3	3	2	3
CO4	3	2	3	2		3	3				3	3	2	3
CO5	3	2	3	2		3	3				3	3	2	3
AVG	3	1.6	2.4	1.2		3	2.6				3	3	2	3

  
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**Course Objectives**

1. To know about racing circuits and its types
2. To learn about various governing bodies and its regulations for motorsports racing
3. To discuss about various principles of track layout and design
4. To identify various materials used in track construction.
5. To understand about various safety and risk management in motorsports racing.

**UNIT I INTRODUCTION**

(9)

Overview of motorsports disciplines - History and evolution of racing circuits. Types of circuits (road, oval, street, drag strips, etc.). Major international racing circuits and their unique features

**UNIT II GOVERNING BODIES AND REGULATIONS**

(9)

Role of The Federation of Motor Sports Clubs of India (FMSCI), Regulatory standards for track design and safety. Homologation process for circuits.

**UNIT III PRINCIPLES OF TRACK LAYOUT AND DESIGN**

(9)

Geometry and layout considerations (straights, corners, chicanes, and banking). Run-off areas, safety barriers, and gravel traps. Gradient, camber, and elevation changes. Design for different motorsport categories.

**UNIT IV MATERIALS AND CONSTRUCTION TECHNIQUES**

(9)

Track surface materials (asphalt, concrete). Drainage systems and climate considerations. Pit lane and paddock design. Environmental and sustainability concerns.

**UNIT V SAFETY AND RISK MANAGEMENT**

(9)

Driver and spectator safety considerations. Safety barriers (TecPro, tire walls, Armco barriers). Emergency response infrastructure and procedures. Simulation of crash scenarios and risk assessment.

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Identify about racing circuits and its types
- CO2: Deliver various governing bodies and its regulations for motorsports racing
- CO3: Discuss about various principles of track layout and design
- CO4: Identify various materials used in track construction.
- CO5: Understand about various safety and risk management in motorsports racing.

**Text Books**

- T1 "Race Car Vehicle Dynamics" by William F. Milliken and Douglas L. SAE International
- T2 "Competition Car Aerodynamics" by Simon McBeath. Haynes Publishing
- T3 "Motorcycle Dynamics" by Vittore Cossalter, LuLu Press

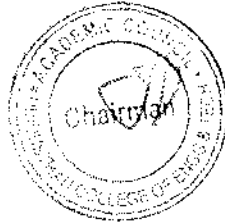
**References**

- R1 "Performance Vehicle Dynamics" by James Balkwill, Publisher: CRC Press
- R2 "Introduction to Modern Vehicle Design" by Julian Happian-Smith, Publisher: SAE International

CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	3	-	-	-	-	2	2	-	2	3	3
CO2	3	2	1	2	-	-	-	-	2	2	-	3	2	2
CO3	3	3	2	3	-	-	-	-	2	2	-	2	3	3
CO4	3	3	2	3	-	-	-	-	2	2	-	3	3	3
CO5	3	2	2	2	-	-	-	-	2	2	-	3	2	3
AVG	3	2.6	2	2.6	-	-	-	-	2	2	-	2.6	2.6	2.8

  
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21AU8203

**AUTOMOTIVE PROTOTYPING**

L	T	P	C
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**Course Objectives**

1. Understand the fundamental principles of automotive prototyping and its significance in vehicle development.
2. Develop proficiency in using computer-aided design (CAD) software for conceptualizing and modeling automotive prototypes.
3. Gain knowledge of different materials used in automotive prototyping and the factors influencing material selection.
4. Acquire skills in prototype fabrication methods such as 3D printing, machining, and molding.
5. Learn testing procedures and methodologies for evaluating automotive prototypes and interpreting test data.

**UNIT I INTRODUCTION TO AUTOMOTIVE PROTOTYPING (9)**

Importance of prototyping in automotive development -Overview of rapid prototyping techniques -Case studies of successful automotive prototypes

**UNIT II DESIGN AND CAD FOR AUTOMOTIVE PROTOTYPING (9)**

Introduction to computer-aided design (CAD) software - Basic CAD modeling techniques - Design considerations for automotive prototypes

**UNIT III MATERIAL SELECTION AND PROTOTYPE FABRICATION (9)**

Properties of materials used in automotive prototyping - Factors influencing material selection - Prototype fabrication methods: 3D printing, machining, molding

**UNIT IV TESTING AND EVALUATION OF AUTOMOTIVE PROTOTYPES (9)**

Introduction to prototype testing procedures - Hands-on testing exercises - Data analysis and interpretation

**UNIT V ITERATIVE PROTOTYPING AND OPTIMIZATION (9)**

Understanding iteration cycles in prototyping - Strategies for design optimization - Case studies of iterative prototyping in automotive industry

**TOTAL: 45 PERIODS**

**Course Outcomes**

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

- CO1: Demonstrate a comprehensive understanding of the role and importance of prototyping in automotive development, elucidating its impact on innovation and design iteration.
- CO2: Apply CAD software proficiently to create detailed designs and virtual prototypes of automotive components, showcasing competency in design visualization and communication.
- CO3: Evaluate material properties and make informed decisions regarding material selection for automotive prototypes, considering factors such as strength, durability, and cost-effectiveness.
- CO4: Execute prototype fabrication using various techniques, demonstrating proficiency in translating design concepts into physical prototypes with accuracy and precision.
- CO5: Conduct systematic testing of automotive prototypes, analyze test results, and propose design modifications or optimizations.

**Text Books**

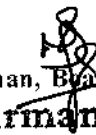
- T1 Paul C. Kurowski Title: "Rapid Prototyping of Digital Systems: A Tutorial Approach" Publisher: Springer,2019.
- T2 Randy H. Shih Title: "AutoCAD 2022 Tutorial First Level 2D Fundamentals" Publisher: SDC,2021.
- T3 George F. Schrader, Ahmad N. S. Shrinivasan Title: "Integrated Product and Process Design and Development: The Product Realization Process, Second Edition" Publisher: 2018.

**References**

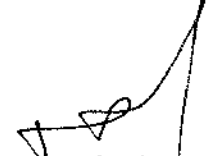
- R1 Mikell P. Groover Title: "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems" Publisher: Wiley,2018.
- R2 Vukica Jovanovic, Nikola Vukicevic, Olga Ivanova Title: "Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics" Publisher: Springer,2015.

**CO PO MAPPING**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	1	2	3	3	-	-	3	-	3	3	2
CO2	1	2	-	2	2	3	3	-	-	3	-	2	2	3
CO3	1	3	2	3	2	3	3	-	-	2	-	2	3	2
CO4	2	3	3	1	2	2	3	-	-	2	-	2	3	2
CO5	1	3	2	2	1	1	2	-	-	2	-	2	3	3
AVG	1.4	2.4	2.4	1.8	1.8	2.4	2.8	-	-	2.4	-	2.2	2.8	2.4

  
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**Course Objectives**

1. To understand the complete knowledge of the vehicle maintenance procedures
2. To acquire skills in handling situations where the vehicle is likely to fail
3. To understand various types of maintenance of vehicles, features and applications
4. To apply the knowledge in servicing vehicle components
5. To analyze the fault in modern engine using engine analyzer

**LIST OF EXPERIMENTS****STUDY EXPERIMENTS:**

1. Tools and instruments required for maintenance
2. Safety aspects with respect to man, machine and tools
3. General procedures for servicing and maintenance schedule
4. Wheel Alignment procedure

**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 and service of transmission system
5. Fault diagnosis and service of driveline system
6. Fault diagnosis and service of braking system
7. Fault diagnosis and service of suspension system
8. Fault diagnosis and service of steering system
9. Fault diagnosis and service of electrical system like battery, starting system, charging system, lighting system etc.
10. Fault diagnosis and service of vehicle air conditioning system
11. Practice the following:
  - a. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel play.
  - b. Air bleeding from hydraulic brakes, air bleeding of diesel fuel system.
  - c. Wheel bearings tightening and adjustment.
  - d. Adjustment of head lights beam.
  - e. Removal and fitting of tire and tube.
  - f. Study and checking of wheel alignment - testing of camber, caster.
  - g. Testing kingpin inclination, toe-in and toe-out
  - h. Cylinder reboring – checking the cylinder bore, Setting the tool and reboring.
  - i. Valve grinding, valve lapping-Setting the valve angle, grinding and lapping and checking for valve leakage
  - j. Tinkering and painting of passenger car door

**TOTAL: 45 PERIODS****Course Outcomes**

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

- CO1: Describe the minor and major tuning of diesel and petrol engines
- CO2: Dismantle, study, perform corrections and assemble the vehicle systems
- CO3: Perform the wheel alignment procedure and tyre removal procedure, etc.
- CO4: Define the procedures of valve grinding, lapping, reboring calibration of fuel injection pump, etc.
- CO5: Find faults, and rectify them to perform maintenance of automotive systems

### LIST OF EQUIPMENT


S.No.	NAME OF THE EQUIPMENT	QTY
1	Engine Analyze	1
2	Cylinder Compression Pressure Gauge	1
3	Vacuum Gauge	1
4	Spark Plug Cleaner and Tester	1
5	Cam Angle and RPM Tester	1
6	Tachometer	1
7	Wheel Alignment Apparatus	1
8	Gas Welding Equipment	1
9	Tyre Remover	1
10	Bearing Puller	1
11	Head Light Alignment Gauge	1
12	Service manuals of Petrol, Diesel Engines	1 Each
13	Cylinder Reboring Machine	1
14	Valve Grinding Machine	1
15	Valve Lapping Machine	1
16	Fuel injection calibration test bench with nozzle tester	1
17	HRD tester, Clamp on meter, Hydrometer	1 Each
18	Tinkering kit	2
19	Surface polisher	2
20	Paint spray gun	2
21	Air compressor	1

### CO PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	2	-	3	2	2	-	-	-	3	2	2
CO2	3	3	2	3	-	3	3	2	-	-	-	2	3	2
CO3	3	3	1	2	-	3	2	2	-	-	-	2	2	3
CO4	3	3	2	2	-	3	2	-	-	-	-	2	2	2
CO5	3	3	2	2	-	2	2	-	-	-	-	2	3	2
AVG	3	3	1.8	2.2	-	2.8	2.2	2	-	-	-	2.2	2.4	2.2

  
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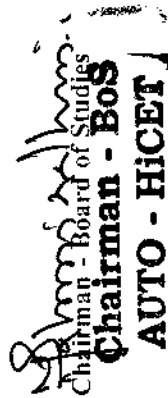


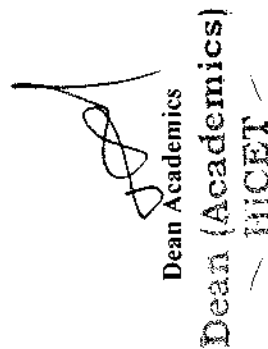
  
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**DETAILS OF COURSE REVISIONS & NEW COURSES INTRODUCED**

SYLLABUS REVISION DETAILS FOR THE REGULATION 2022 and 2019R – SEMESTER II, IV, VI & VIII						
S.NO	COURSE CODE/COURSE NAME	SUGGESTION BY EXPERTS	EXISTING CONTENT (IN THE AY 2023-24 EVEN)	REVISED CONTENT (FOR AY 2024-25 EVEN)	TYPE OF REVISION/ DELETION/ INSERTION/ MODIFICATION	PERCENT AGE OF REVISION
1.	22CY2154 - Chemistry For Mechanical Sciences	New course being introduced in Second Semester Syllabus (for the batch admitted during 2024 – 2025)				
2.	22AU6202 - Automotive Emission and Pollution Control	New course being introduced in Sixth Semester Syllabus (for the batch admitted during 2022 – 2023)				
3.	22HE6101 - Professional Ethics	New course being introduced in Sixth Semester Syllabus (for the batch admitted during 2022 – 2023)				
4.	22AU6302 - Autonomous and connected Vehicle	New course being introduced in Sixth Semester Syllabus (for the batch admitted during 2022 – 2023)				
5.	22AU6309 - Wind Energy Technology	New course being introduced in Sixth Semester Syllabus (for the batch admitted during 2022 – 2023)				
6.	NPTEL COURSES	As per the UGC guideline on “Curriculum and Credit Framework for UG Programmes”, students from the 2023-2024 batch are required to complete <b>two NPTEL Courses</b> during their Academic tenure. These courses should be completed before <b>Seventh Semester</b> . Departments are encouraged to include SWAYAM-NPTEL Course to ensure students earn credits through online platforms. The total credits for NPTEL courses should be 6 Credits (2 Courses)				
7.	21AU8601 - Electric and Hybrid vehicles	New course being introduced in Eighth Semester Syllabus (for the batch admitted during 2021 – 2022)				
8.	21AU8201 - Energy Storage Techniques for Electric Vehicles.	New course being introduced in Eighth Semester Syllabus (for the batch admitted during 2021 – 2022)				
9.	21AU8202 - Motorsports racing circuits and Design	New course being introduced in Eighth Semester Syllabus (for the batch admitted during 2021 – 2022)				
10.	21AU8203 - Automotive Prototyping	New course being introduced in Eighth Semester Syllabus (for the batch admitted during 2021 – 2022)				

<p>11.</p>	<p>21 AU8302- Computational Fluid Dynamics</p>	<p>Dr Mothilal T suggested reducing the syllabus in Computational Fluid Dynamics as the course offers 3 credits.</p>	<p><b>UNIT I INTRODUCTION</b> Application areas of CFD- Basic concepts of fluid flow - Governing equations- conservation of mass-momentum and energy – Navier-stokes and energy equation for Newtonian fluid-Mathematical classification of flow – Hyperbolic- parabolic- elliptic and mixed flow types.</p> <p><b>UNIT II - DISCRETISATION</b> Finite difference method – Forward-backward and central difference schemes, explicit and implicit methods - Numerical solution for heat transfer and fluid flow problems for steady state and transient conditions</p> <p><b>UNIT III CFD TECHNIQUES</b> Lax - Wendroff technique- McCormack's technique- relaxation technique- SIMPLE algorithm- Fluid flow and convection problems – Upwind scheme and stability criteria.</p>	<p><b>UNIT I CLASSIFICATION OF PDES, GOVERNING EQUATIONS</b> Introduction to Computational Fluid Dynamics and Principles of Conservation: Continuity Equation, Navier Stokes Equation, Energy Equation and General</p> <p><b>UNIT II PRINCIPLES OF COMPUTATIONAL METHODS</b> Fundamentals of Discretization: Finite Element Method, Finite Difference and Finite Volume Method, Consistency. Stability and Convergence.</p> <p><b>UNIT III STEADY AND UNSTEADY DIFFUSION, ADVECTION-DIFFUSION PROBLEMS</b> Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation.</p>	<p>Deletion and inclusion of topics</p> <p>Deletion and inclusion of topics</p> <p>Deletion and inclusion of topics</p>	<p>30%</p>
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