



HINDUSTAN
INSTITUTE OF TECHNOLOGY & SCIENCE
(DEEMED TO BE UNIVERSITY)

B. TECH. AUTOMOBILE ENGINEERING

(Duration: 4 Years)

REGULATION 2022
(in line with NEP 2020)

CURRICULUM and SYLLABUS

(Applicable for students admitted from 2024 onwards)

DEPARTMENT OF AUTOMOBILE ENGINEERING

SCHOOL OF ENGINEERING AND TECHNOLOGY

HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE



HINDUSTAN

INSTITUTE OF TECHNOLOGY & SCIENCE
(DEEMED TO BE UNIVERSITY)

MOTTO, VISION, MISSION AND VALUE STATEMENT OF INSTITUTE

Motto

To Make Every Man a Success and No Man a Failure.

Vision

To be an International Institute of Excellence, providing a conducive environment for education with a strong emphasis on innovation, quality, research and strategic partnership blended with values and commitment to society.

Mission

- To create an ecosystem for learning and world class research.
- To nurture a sense of creativity and innovation.
- To instill highest ethical standards and values with a sense of professionalism.
- To take up activities for the development of Society.
- To develop national and international collaboration and strategic partnership with industry and institutes of excellence.
- To enable graduates to become future leaders and innovators.

Value Statement

Integrity, Innovation, Internationalization

DEPARTMENT OF AUTOMOBILE ENGINEERING

VISION

To enable the graduates to be successful in their career as an Automobile Engineer.

MISSION

- M1: To inculcate knowledge in Automobile Engineering
- M2: To impart skills and training on the advancements in Automobile Engineering such as Automotive Electronics, Autonomous Vehicles, etc.
- M3: To instill the highest ethical standards to be a Professional Automobile Engineer for social development.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- PEO-I : Employability/ Industry Ready:** To provide in-depth knowledge in Automobile Engineering and awareness of latest development in allied fields of engineering to the students and make them industry ready engineers (T – shaped engineers).
- PEO-II : Research:** To provide a range of specialized modules integrated within the structured learning environment for encouraging the students for higher studies and do research in automobile and related fields.
- PEO-III : Entrepreneurship:** To develop a challenging environment that supports and encourages the students to become an entrepreneur.
- PEO-IV : Individual and Team work:** To develop a culture that promotes individual and team work for carrying out innovative projects, assignments and research work in engineering sciences.
- PEO-V : Worldwide Recognition:** A competitive degree structure is provided, that responds to time, need and technology.

PROGRAMME OUTCOMES (PO's)

Engineering Graduates will be able to:

- PO1 : Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 : Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 : Design Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified

needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

- PO4 : Conduct Investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 : Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6 : The Engineer & Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 : Environment & Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 : Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 : Individual & Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 : Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 : Project Management & Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 : Life-Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES: (PSO's)

Graduates of B. Tech Automobile Engineering students will be able to

PSO1 : Design and Analysis: Design, Analysis, Fabrication and Testing of vehicles, which enable the students to compete globally.

PSO2 Environment and Society: Carry out research in fuel economy, emission reductions, alternate fuels and solar vehicle for the benefit of the society and environment.

PEOs and POs:

B.Tech. Automobile Engineering Program Outcomes (POs) leading to the achievements of the objectives (PEOs) are summarised in the following table.

Programme Educational Objectives (PEOs)	Programme Outcomes (POs)													
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
I	2	1	2	2	2	2	1	1	3	1	2	3	2	3
II	3	2	2	1	2	1	2	2	2	1	1	2	3	2
III	2	1	3	2	3	2	1	1	2	2	2	3	2	3
IV	3	2	2	1	2	1	2	2	1	1	2	2	3	2
V	2	1	2	2	2	1	1	1	2	1	2	2	2	3

YEAR 1	SEMESTER 1	Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
		1	Matrices and Calculus	2.8	2.6	1.6	1.4	1.6	-	-	-	-	-	-	1.4	1.6	1.4
		2	Engineering Physics	3	3	1.4	1.4	1.8	-	-	-	2.6	-	-	2.2	1.4	2
			OR														
			Engineering Materials	3	2	1.4	-	-	-	1.6	-	-	-	-	2	1.6	1.6
		3	Professional Communication	-	-	-	-	-	-	-	1.4	0.4	2.8	1.8	2	1.2	1.4
		4	Programming Fundamentals using C Or Programming in Python	2.4	2.4	2.4	1.2	1	1.4	-	1.2	1	0.8	0.8	1.2	1.8	1.4
			OR														
			Engineering Graphics and Computer Aided Design	2.4	1.4	1.2	-	1.6	-	-	1.4	1.6	1.8	-	2	1	0.8
		5	Design Thinking	1.4	1.2	1.6	2	1.8	2.8	2.8	2	2.4	2.4	0.8	2	2.4	2.6
		6	Engineering Practices Lab	3	2	-	2	-	1	-	-	-	-	-	-	2.3	1.3
			OR														
			Fab Lab for Core Engineering	1.4	1.4	1.6	1.6	1.4	-	-	-	-	-	-	1.4	1.6	1.6
		7	Outreach (NCC) – Level I #	1	2	1	1	-	2	1	3	2	3	3	2	-	-
			OR														
			Outreach (NSS, Y's Men, Rotaract) – Level I #	1	2	1	1	-	2	1	3	2	3	3	2	-	-
		8	Tamil	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Hindi	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Telugu	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-

			OR														
			French	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			German	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Spanish	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Korean	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Mandarin	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Japanese	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			OR														
		Universal Human Values	1	1	1	1	1	2	2	3	2	2	3	1	-	-	
		9	Tamil Culture and Technology	-	-	-	-	-	1	1	2	3	-	-	-	-	-

	SEMESTER 2	Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	
		1	Analytical Mathematics	3	3	2	1	2	-	-	-	-	-	-	-	2	3	0
		2	Engineering Physics	3	3	1.4	1.4	1.8	-	-	-	2.6	-	-	2.2	1.4	2	
			OR															
			Engineering Materials	3	2	1.4	-	-	-	1.6	-	-	-	-	2	1.6	1.6	
		3	Advanced Communication Skills	-	-	-	-	-	-	-	1.4	0.4	2.8	1.8	2	1.2	1.4	
		4	Mechanics of Rigid bodies	3	2	3	2	1	2	1	1	1	1.2	1	2	1	2	
		5	Programming Fundamentals using C Or Programming in Python	2.4	2.4	2.4	1.2	1	1.4	-	1.2	1	0.8	0.8	1.2	1.8	1.4	

			OR														
			Engineering Graphics and Computer Aided Design	2.4	1.4	1.2	-	1.6	-	-	1.4	1.6	1.8	-	2	1	0.8
		6	Engineering Practices Lab	3	2	-	2	-	1	-	-	-	-	-	-	2.3	1.3
			OR														
		6	Fab Lab for Core Engineering	1.4	1.4	1.6	1.6	1.4	2	2	2	1	2	1	1.4	1.6	1.6
			OR														
		7	Outreach (NCC) – Level 2 #	1	2	1	1	-	2	1	3	2	3	3	2	-	-
			OR														
		7	Outreach (NSS, Y's Men, Rotaract) – Level 2 #	1	2	1	1	-	2	1	3	2	3	3	2	-	-
			OR														
		8	Tamil	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Hindi	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Telugu	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			OR														
			French	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			German	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Spanish	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Korean	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Mandarin	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
			Japanese	-	-	-	-	-	-	0.4	0.4	0.4	3	0.4	0.6	-	-
		9	OR														
			Universal Human Values	1	1	1	1	1	2	2	3	2	2	3	1	-	-
		9	Mandatory Course I														

			Mandatory Course I is a Non-credit course (Student shall select one course from the list given under Mandatory Course I)														
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YEAR 2	SEMESTER 3	Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
		1	Partial Differential Equations and Transforms	3	3	2	2	2	-	-	-	-	-	-	-	1.4	1.6
		2	Public Speaking and Group Discussion	-	-	2	2	-	-	-	2.6	2	3	2	3	1.2	1.6
		3	Thermodynamics and Heat transfer	3	3	3	3	3	1	1	-	1	-	1	1	2	2
		4	Automotive Engine Technology	3	2	2	2	2.4	2.4	2.4	1	2	1	1	3	3	3
		5	Materials and Manufacturing Process of Automotive Components	1.6	1.2	1.4	-	0.2	0.2	-	-	-	0.4	-	1.4	1.4	1.2
		6	Department Elective-1														
		7	Environmental Science and Sustainable Development	2	2	2	-	-	1	3	-	-	-	-	2	1.4	1.4
		8	Design Project – 1	3	3	2	1	3	2	1	3	3	3	3	2	2	2.3
		9	Internship -1 (To be carried out in summer after 2 nd semester and evaluated in 3 rd semester)	2	2	3	3	2	0.6	1	2	1.6	1.6	1.6	0.6	0.6	1
		10	Mandatory Course II														

			Mandatory Course II is a Non-credit course (Student shall select one course from the list given under Mandatory Course II)														
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YEAR 2	SEMESTER 4	Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
		1	Probability and Statistics	3	3	1.2	0.8	-	-	-	-	-	0.4	0.4	0.2	-	-
		2	Professional Editing and Project Writing	-	-	-	2	-	-	-	-	-	3	-	2	-	-
		3	Mechanics of Solids and Fluids	3	3	1.6	-	0.6	-	-	2	2	0.6	-	3	2	2
		4	Automotive Chassis and Driveline System	3	3	3	1.8	2	2.2	0.6	1.8	-	-	1.8	3	3	2
		5	Two and Three-wheeler EV Technology (Industry Collaborated Course)	0.6	0.4	0.6	-	0.6	0.2	-	-	-	-	-	-	1	1.2
		6	Department Elective-2														
		7	Non-Department Elective-1														
		8	Design Project – 2	3	3	2.6	2	3	2	2	3	3	3	3	1	2	2
		9	Personality Development and Soft Skill Techniques	-	-	-	2	-	-	-	-	-	3	-	2	-	-
		10	Mandatory Course III Mandatory Course III is a Non-credit course (Student shall select one course from the list given under Mandatory Course III)														

YEAR 3	SEMESTER 5	Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
		1	Logical Reasoning and Verbal Ability	-	-	-	-	-	-	-	-	1.2	3	-	2	-	-
		2	Automotive System Design	2.4	2.2	1.4	1.4	0.2	0.2	-	-	-	0.4	-	2.2	1.6	1.4
		3	Mechanics of Machines	2.4	2.2	0.8	1	1.4	1.6	1.8	3	2.6	1	2	2	1.6	1.8
		4	Automotive Electrical and Electronics	0.4	2	0.6	2	0.6	0.2	-	-	-	1	1	2	0.8	1.6
		5	Department Elective-3														
		6	Non-Department Elective-2														
		7	Design Project – 3	3	3	2.6	2	3	2	2	3	3	3	3	1	2	2.6
		8	Entrepreneurship	2.75	2.5	1.75	2.5	2.25	2.75	1.75	1.5	2.75	2.5	2	3	2.5	2.5
		9	Problem Solving using Quantitative Techniques	-	-	-	-	-	-	-	-	1.2	3	-	2	-	-
		10	Internship -2 (to be evaluated in 5 th semester. To be carried out in summer after 4 th semester))	2	2	3	3	2	0.6	1	2	1.6	1.6	1.6	0.6	0.6	1

YEAR 3	SEMESTER 6	Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
		1	Vehicle Dynamics	2.6	2.6	2.6	2.6	2.6	-	2.4	-	-	1	1	2.6	1.6	1.4
		2	Design and simulation of Electric and Hybrid Vehicles	3	3	3	2	3	2	2	1	2	1	1	3	3	3
		3	Control system for Automotive applications	3	3	2.4	2	1.2	-	-	-	-	-	-	1.2	1.6	1.4
		4	Department Elective-4														
		5	Non-Department Elective-3	3	3	3	3	2	-	1	-	2	3	3	0.8	2	2
		6	Introduction to Industry 4.0	3	3	3	3	2	-	1	-	2	3	3	0.8	2	2
		7	Design Project – 4	3	3	2.6	2	3	2	2	3	3	3	3	1	1.6	1.6
		8	Profesional Skill and Ethics	3	3	2.6	2	3	2	2	3	3	3	3	1	1.6	1.6

YEAR 4	SEMESTER 7	Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
		1	English for Competitive Examinations	-	0.8	1.2	1.2	-	1.6	-	-	2	3	1	3	-	-
		2	Fundamentals of Finite Element Analysis	3	3	2.4	3	3	1.2	0.6	-	-	-	0.6	3	3	3
		3	Vehicle Diagnostics and Maintenance	3	3	2	3	3	2	2	2	2	1	2	2	1	2.2
		4	Advanced Vehicle Technology	2.6	1.2	2.2	2.4	2.4	-	-	-	-	-	1.4	2.6	2.4	1.8
		5	Department Elective-5														
		6	Non-Department Elective-4														

	7	Research Methodology & IPR	2.4	2.8	1.2	1.2	3	2.4	1.8	2	2.2	2.6	2	3	2	2
	8	Project Phase - 1	3	3	2	3	2	3	2	3	2	3	2	2	2	2

YEAR 4	SEMESTER 8	Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS 01	PS 02
		1	Project Phase - 2	3	3	3	3	3	3	2	3	3	3	3	3	3	3

DEPARTMENT ELECTIVE COURSES: VERTICALS

	Vertical 1	Vertical 2	Vertical 3	Vertical 4
SEM	Electric Vehicle Technology	Intelligent Mobility	Engine and Vehicle Technology	Design and Manufacturing
III	Electric Drives and Control	Instrumentation for Intelligent Mobility	Alternative Fuels and Energy Systems	Production Technology
	OR	OR	OR	OR
	Policy for E-Mobility	Intelligent Transportation system	Vehicle body engineering	Product Design and Development
IV	Battery Technology	Advanced Driver Assistance System	Automotive Pollution and Control	Computer Integrated Manufacturing
	OR	OR	OR	OR
	Electric and Hybrid vehicles	V2V and V2X Technology	Off Road Vehicles	Process Planning and Cost Estimation
V	Charging Technology	ECU Model Based System Design	Vehicle Design Data Characteristics	Digital Manufacturing

	OR	OR	OR	OR
	Power Electronics for EV	Cyber security for Automotive Engineers	Design of Engine Exhaust system	Industrial Automation and Robotics
VI	Modelling and Simulation of EV	Automotive Safety Systems	Renewable Source of Energy	Design of Experiments
	OR	OR	OR	OR
	Coding for EV	Automotive Electronic Management System	Automotive Heating Ventilation Air Conditioning (HVAC)	Industrial Engineering and Management
VII	Computer Architecture and Data Analytics	Self-Driving Cars	Vibration and Noise Control	Computational Fluid Dynamics
	OR	OR	OR	OR
	Smart Grid for EV	Pose estimation and state estimation of self-driving cars	Fuel Cell Technology	Lean Manufacturing and Six sigma

VERTICAL 1: ELECTRIC VEHICLE TECHNOLOGY

Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
1	Electric Drives and Control	3	2	3	2	2	3	3	2	3	3	3	3	3	3
2	Policy for E-Mobility	3	1	2	1	1	2	3	2	1	1	1	3	3	3
3	Battery Technology	1.4	-	1.2	-	-	1.2	1.4	-	-	-	1.4	1.2	1.2	1.6
4	Electric and Hybrid vehicles	0.6	0.4	0.6	-	0.6	0.2	-	-	-	-	-	-	1	1.2
5	Charging Technology	2.2	2.2	1.8	2.8	2.2	2	1.8	1.6	1.6	2	1.8	1.8	3	3
6	Power Electronics for EV	3	2	3	2	2	3	3	2	3	3	3	3	3	3

7	Modelling and Simulation of EV	3	1	2	1	1	2	3	2	1	1	1	3	3	3
8	Coding for EV	1.4	-	1.2	-	-	1.2	1.4	-	-	-	1.4	1.2	1.2	1.6
9	Computer Architecture and Data Analytics	0.6	0.4	0.6	-	0.6	0.2	-	-	-	-	-	-	1	1.2
10	Smart Grid for EV	2.2	2.2	1.8	2.8	2.2	2	1.8	1.6	1.6	2	1.8	1.8	3	3

VERTICAL 2: INTELLIGENT MOBILITY

Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
1	Instrumentation for Intelligent Mobility	2.6	2.6	2.6	2.4	1.6	1	0.4	-	-	-	0.6	0	2.6	2.2
2	Intelligent Transportation system	1.8	2	1.2	2.2	0.4	0.6	0.4	1.2	0.4	1.4	1	1.4	1.4	1.6
3	Advanced Driver Assistance System	2.6	2.6	2.6	2.4	1.6	1	0.4	-	-	-	0.6	-	2.6	2.2
4	V2V and V2X Technology	2.6	2.6	2.6	2.4	1.6	1	0.4	-	-	-	0.6	-	2.6	2.2
5	ECU Model Based System Design	2.6	1.2	2.2	-	-	2.4	2.8	-	-	-	1	2.6	1.8	2
6	Cyber security for Automotive Engineers														
7	Automotive Safety Systems	2.2	2.2	1.8	2.8	2.2	2	1.8	1.6	1.6	2	1.8	1.8	3	3
8	Automotive Electronic Management System	0.6	0.4	0.6	-	0.6	0.2	-	-	-	-	-	1.4	1.4	1.6
9	Self-Driving Cars	1.6	1.2	1.4	1.2	-	1.8	1.2	-	1.2	2	1	1.6	1.6	1.2
10	Pose estimation and state estimation of self-driving cars	1.8	2	1.2	2.2	0.4	0.6	0.4	1.2	0.4	1.4	1	1.4	1.4	1.6

VERTICAL 3: ENGINE AND VEHICLE TECHNOLOGY

Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
1	Alternative Fuels and Energy Systems	3	3	-	0.8	1.4	-	-	-	3	-	-	3	1.4	1.6
2	Vehicle body engineering	2.4	2.4	-	0.8	1.4	-	-	-	2.2	-	-	2.4	1.4	1.2
3	Automotive Pollution and Control	3	3	-	0.8	1.4	-	-	-	3	-	-	3	1.4	2
4	Off Road Vehicles	2.6	1.2	2.2	-	-	2.4	2.8	-	-	-	1.4	2.6	2.4	1.8
5	Vehicle Design Data Characteristics	2.6	2.4	2.4	2.4	-	-	-	-	-	1.8	1.2	2.4	2.4	3
6	Design of Engine Exhaust system	1.4	0.8	1.4	0.8	1	0.2	-	-	-	-	-	1.4	1.4	1.6
7	Renewable Source of Energy	1	1	1	1	2	2	2	2	2	2	1	1	1	1
8	Automotive Heating Ventilation Air Conditioning (HVAC)	3	1.4	2	1.4	1	1.2	-	1.2	-	-	1	1	1	1
9	Vibration and Noise Control	2.6	1.4	2.2	2.4	2.4	-	-	-	-	-	1.4	2.6	2.4	1.8
10	Fuel Cell Technology	2.6	1.4	2	3	1	2	2.4	0	0	0	1.4	2.6	2.4	2

VERTICAL 4: DESIGN AND MANUFACTURING

Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
1	Production Technology	2.6	2.2	2.6	2	2.6	1.4	1.4	-	1.4	2.4	1.6	2	1.6	1.6
2	Product Design and Development	3	2.8	3	2.8	3	2	2.8	2.8	2	3	2.4	-	1.4	1.2
3	Computer Integrated Manufacturing	1.4	1.6	1.4	1.2	2.6	0.6	-	-	2.4	1.4	2.4	1.4	1.4	1.4

4	Process Planning and Cost Estimation	2.4	2.6	1.8	1.6	1.4	1.2	1.4	-	1.4	-	1.4	1.4	1.2	1.4
5	Digital Manufacturing	2.6	1.4	1.4	1.4	2.4	-	-	-	-	-	-	2.6	2.4	1.8
6	Industrial Automation and Robotics	3	3	3	3	2	2	2	2	1	1	1	1	3	3
7	Design of Experiments	1.6	1.2	1.4	-	0.2	-	-	-	-	0.4	-	1.4	1.4	1.2
8	Industrial Engineering and Management	3	2.2	1.6	1.4	2.8	2.6	2.6	1.6	2.4	2.4	1.8	1.6	3	2
9	Computational Fluid Dynamics	2.2	2.6	2.2	2.8	2.4	2.2	2	2	1.8	2	1.8	2.2	3	3
10	Lean Manufacturing and Six sigma	3	3	3	3	2	2	2	2	2	2	1	1	3	3

NON DEPARTMENT ELECTIVES

NON DEPARTMENT ELECTIVE-1

Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
1	Automotive Vehicle Technology	3	2.4	-	-	3	2	2.8	2	3	2	-	-		
2	Elements of Motorsports Engineering	1.8	1.8	0.2	1.8	0.4	1.8	0.4	0.2	0.6	-	0.2	1.8		
3	Energy from Renewable Sources	3	3	3	3	1	2	1	2	1	1	1	2		
4	Future Fuels for IC Engines	3	2	2	2.6	2.6	3	3	1	2	1	1.4	3		

NON DEPARTMENT ELECTIVE- 2

Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
1	Smart Materials for Automotive Applications	2.6	2	2	2.6	2.6	3	3	1	2	1	1.4	3		
2	Industrial Safety and Hazard Management	2	-	2	-	-	2	3	-	-	-	-	3		
3	Hydrogen Engine Technology	3	2	2	2.6	2.6	3	3	1	2	1	1.4	3		

4	E-Mobility: Policy & Business	3	1	2	1	1	2	3	2	1	1	1	3		
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NON DEPARTMENT ELECTIVE-3

Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
1	Automotive Safety Systems	2.2	2.2	1.8	2.8	2.2	2	1.8	1.6	1.6	2	1.8	1.8		
2	Introduction to Intelligent Transport Systems	1.8	2	1.2	2.2	0.4	0.6	0.4	1.2	0.4	1.4	1	1.4		
3	Fuel Cell Technology	2.6	1.4	2	3	-	-	-	-	-	-	1.4	2.6		
4	Sensor Technology & Sensor Fusion for Autonomous Car	0.8	0.8	0.4	0.6	0.4	0.4	0.2	0.2	-	0.2	-	-		

NON DEPARTMENT ELECTIVE- 4

Sl. No	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
1	Plant Layout and Material Handling	3	2	-	1	2	-	2.6	-	-	-	2.6	-		
2	Electric Vehicle Technology-Two and Three-Wheeler	0.6	0.4	0.6	-	0.6	0.2	-	-	-	-	-	-		
3	Introduction to Self- Driving Cars	2.6	2.6	2.6	2.4	1.6	1	0.4	-	-	-	0.6	-		
4	Automotive Air-conditioning and Climate Control.	3	1.4	2	1.4	1	1.2	-	1.2	-	-	1	1		

Note: PSO1 and PSO2 pertains to the department of the student opting for this course.

B. TECH. AUTOMOBILE ENGINEERING

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits: In the light of the fact that a typical Model Four-year Under Graduate degree program in Engineering has about 160 credits, we have adopted 165 credits.

C. Structure of UG Program: The structure of UG program shall have essentially the following categories of courses with the breakup of credits as given:

S. No.	Course Category	Course Category	Breakup of Credits
1.	HS	Humanities & Social Science Courses	16
2.	BS	Basic Science Courses	24
3.	ES	Engineering Science Courses	19
4.	PC	Program Core Courses	57
5.	DE	Department Elective Courses	15
6.	NE	Non Department Elective Courses	12
7.	EEC	Employment Enhancement Courses	22
8.	MC	Mandatory Courses	*
TOTAL			165
9.	HN	Honors Courses	12
10.	MN	Minors Courses	9

*Non Credit Course

CURRICULUM COURSE DISTRIBUTION (BASED ON CREDITS)

Semester	HS	BS	ES	PC	DE	NE	EEC	Total Credits per semester

1	6	8	8					22
2	5	8	5	4				22
3	1	4	2	10	3		2	22
4	1	4		10	3	3	1	22
5	1		2	10	3	3	2	21
6	1			13	3	3	1	21
7	1		2	10	3	3	3	22
8							13	13
Total Credits	16	24	19	57	15	12	22	165

CURRICULUM COURSE DISTRIBUTION (BASED ON COURSE COUNT)

Semester	HS	BS	ES	PC	DE	NE	EEC	MC	Total Courses per semester
1	4	2	2	1					9
2	3	2	2	1				1	9
3	1	1	1	3	1		2	1	10
4	1	1		3	1	1	1	1	9
5	1		1	3	1	1	2		9
6	1			4	1	1	1		8
7	1		1	3	1	1	1		8
8							1		1
Total Courses	12	6	8	17	5	4	8	3	63

MC : Mandatory Course

CREDIT COUNT

Semester	Credit Count
1	22
2	22
3	22
4	22
5	21
6	21
7	22
8	13
	165

B. TECH. AUTOMOBILE ENGINEERING
CURRICULUM FRAMEWORK FOR SEMESTERS I TO VIII

FRAMEWORK OF CURRICULUM 2022 (in line with NEP 2020)									
SEMESTER – I									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	EMA51001	Matrices and Calculus	3	0	2	4	2	5
2	BS	Any One Course to be Opted		3	0	2	4	2	5
		EPH51001	Engineering Physics						
		ECT51001	Engineering Materials						
3	HS	GLS51018	Professional Communication	3	0	0	1	1	3
4	ES	Any One Course to be Opted		2	0	2	3	2	4
		ECS51009	Programming Fundamentals using C						
		ECS51010	Programming in Python						
		OR							
		EME51001	Engineering Graphics and Computer Aided Design						
5	ES	EGE51002	Design Thinking	2	0	2	3	2	4
6	ES	Any One Course to be Opted		0	0	4	2	2	4
		EGE51406	Engineering Practices Lab						
		EGE51408	Fab Lab for Core Engineering						
7	HS	Any One Course to be Opted (Outreach)		0	0	2	1	4	2
		GGE51401	Outreach (NCC) – Level I #						
		GGE51402	Outreach (NSS, Y’s Men, Rotaract) – Level I #						
8	HS	Any One Course to be Opted (Indian / foreign language)		2	0	0	2	2	2
		GLS51008	Tamil						
		GLS51009	Hindi						
		GLS51010	Telugu						
		GLS51011	French						
		GLS51012	German						
		GLS51013	Spanish						
		GLS51014	Korean						
		GLS51015	Mandarin						
		GLS51016	Japanese						
		OR							
		GGE51001	Universal Human Values						
9	HS	GLS51017	Tamil Culture and Technology	1	0	0	1	2	1
			Total	16	0	14	21	19	30

Students should choose Level I and Level II of same outreach course in the semester 1 and 2 respectively.

SEMESTER – II									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	EMA51002	Analytical Mathematics	3	0	2	4	2	5
2	BS	Any One Course to be Opted		3	0	2	4	2	5
		EPH51001	Engineering Physics						
		ECT51001	Engineering Materials						
3	HS	GLS51019	Advanced Communication Skill	3	0	0	1	1	3
4	PC	EAT51001	Mechanics of Rigid bodies	2	1	2	4	2	5
5	ES	Any One Course to be Opted		2	0	2	3	2	4
		ECS51009	Programming Fundamentals using C						
		ECS51010	Programming in Python						
		OR							
		EME51001	Engineering Graphics and Computer Aided Design						
6	ES	Any One Course to be Opted		0	0	4	2	2	4
		EGE51406	Engineering Practices Lab						
		EGE51408	Fab Lab for Core Engineering						
7	HS	Any One Course to be Opted		0	0	2	1	4	2
		GGE51403	Outreach (NCC) – Level II #						
		GGE51404	Outreach (NSS, Y’s Men, Rotaract) – Level II #						
8	HS	Any One Course to be Opted (Indian / Foreign language)		2	0	0	2	2	2
		GLS51008	Tamil						
		GLS51009	Hindi						
		GLS51010	Telugu						
		GLS51011	French						
		GLS51012	German						
		GLS51013	Spanish						
		GLS51014	Korean						
		GLS51015	Mandarin						
		GLS51016	Japanese						
		OR							
		GGE51001	Universal Human Values						
9	MC	*****	Mandatory Course I Mandatory Course I is a Non-credit course (Student shall select one course from the list given under Mandatory Course I)	3	0	0	*	2	3
			Total	18	1	14	21	19	33

Students should choose Level I and Level II of same outreach course in the semester 1 and 2 respectively.

* Non Credit Course

FRAMEWORK OF CURRICULUM 2022 (in line with NEP 2020)									
SEMESTER – III									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	EMA51003	Partial Differential Equations and Transforms	3	1	0	4	2	4
2	HS	GLS51400	Public Speaking and Group Discussion	0	0	3	1	1	3
3	PC	EAT51002	Thermodynamics and Heat transfer	2	1	2	4	2	5
4	PC	EAT51003	Automotive Engine Technology	2	0	2	3	2	4
5	PC	EAT51004	Materials and Manufacturing Process of Automotive Components	2	0	2	3	2	4
6	DE	EAT515xx	Department Elective-1	2	0	2	3	2	4
7	ES	EGE51003	Environmental Science and Sustainable Development	2	0	0	2	2	2
8	EEC	EAT51800	Design Project – 1	0	0	2	1	6	2
9	EEC	EAT51801	Internship -1 (To be carried out in summer after 2 nd semester and evaluated in 3 rd semester)	#			1	2	0
10	MC	*****	Mandatory Course- II Mandatory Course II is a Non-credit course (Student shall select one course from the list given under Mandatory Course II)	3	0	0	*	2	3
Total				16	2	13	22	23	31
* Non Credit Course # 15 Days Minimum									
SEMESTER – IV									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	EMA51007	Probability and Statistics	3	1	0	4	2	4
2	HS	GLS51004	Professional Editing and Project Writing	2	0	0	1	1	2
3	PC	EAT51005	Mechanics of Solids and Fluids	2	1	2	4	2	5

4	PC	EAT51006	Automotive Chassis and Driveline System	2	0	2	3	2	4
5	PC	EAT51007	Two and Three-wheeler EV Technology (Industry Collaborated Course)	2	0	2	3	2	4
6	DE	EAT515xx	Department Elective-2	2	0	2	3	2	4
7	NE	Exx517xx	Non-Department Elective-1	2	0	2	3	2	4
8	EEC	EAT51802	Design Project – 2	0	0	2	1	6	2
9	HS	ETP51853	Personality Development and Soft Skill Techniques	0	0	3	2	2	3
10	MC	*****	Mandatory Course- III Mandatory Course III is a Non-credit course (Student shall select one course from the list given under Mandatory Course III)	3	0	0	*	2	3
Total				18	2	15	24	23	35

* Non Credit Course

FRAMEWORK OF CURRICULUM 2022 (in line with NEP 2020)									
SEMESTER – V									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	HS	ETP51852	Logical Reasoning and Verbal Ability	1	0	2	1	1	3
2	PC	EAT51008	Automotive System Design	2	1	2	4	2	5
3	PC	EAT51009	Mechanics of Machines	2	0	2	3	2	4
4	PC	EAT51010	Automotive Electrical and Electronics	2	0	2	3	2	4
5	DE	EAT515xx	Department Elective-3	2	0	2	3	2	4
6	NE	Exx517xx	Non-Department Elective-2	2	0	2	3	2	4
7	EEC	EAT51803	Design Project – 3	0	0	2	1	6	2
8	ES	EGE51004	Entrepreneurship	2	0	0	2	6	2

9	HS	ETP51855	Problem Solving using Quantitative Techniques	1	0	2	1	2	3
10	EEC	EAT51804	Internship -2 (to be evaluated in 5 th semester. To be carried out in summer after 4 th semester))	#			1	0	0
Total				14	1	16	22	25	31

15 Days minimum

SEMESTER – VI									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PC	EAT51011	Vehicle Dynamics	2	1	2	4	2	5
2	PC	EAT51012	Design and simulation of Electric and Hybrid Vehicles	2	0	2	3	2	4
3	PC	EAT51013	Control system for Automotive applications	2	0	2	3	2	4
4	DE	EAT515xx	Department Elective-4	2	0	2	3	2	4
5	NE	Exx517xx	Non-Department Elective -3	2	0	2	3	2	4
6	PC	EAT51014	Introduction to Industry 4.0	2	0	2	3	6	4
7	EEC	EAT51805	Design Project – 4	0	0	2	1	6	2
8	MC	ETP51854	Professional Skill and Ethics	0	0	3	*	2	3
Total				12	1	17	20	24	30

FRAMEWORK OF CURRICULUM 2022 (in line with NEP 2020)									
SEMESTER – VII									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	HS	GLS51006	English for Competitive Examinations	0	0	2	1	1	2
2	PC	EAT51015	Fundamentals of Finite Element Analysis	2	1	2	4	2	5
3	PC	EAT51016	Vehicle Diagnostics and Maintenance	2	0	2	3	2	4

4	PC	EAT51017	Advanced Vehicle Technology	2	0	2	3	2	4
5	DE	EAT515xx	Department Elective-5	2	0	2	3	2	4
6	NE	Exx517xx	Non-Department Elective-4	2	0	2	3	2	4
7	ES	EGE51005	Research Methodology & IPR	2	0	0	2	2	2
8	EEC	EAT51806	Project Phase 1	0	0	6	3	6	6
Total				12	1	18	22	19	31
SEMESTER – VIII									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	EEC	EAT51807	Project Phase - 2	0	0	26	13	10	26
Total				0	0	26	13	10	26
Total Credits for the Program							165		

MANDATORY COURSES I

SEMESTER – II									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	MC	GGE51011	Introduction to Women and Gender Studies	3	0	0	*	2	3
2	MC	GGE51012	Public and Personal Administration	3	0	0	*	2	3
3	MC	GGE51013	Constitution of India	3	0	0	*	2	3
4	MC	EGE51006	Law for Engineers	3	0	0	*	2	3
5	MC	GGE51015	Indian Knowledge System (IKS)	3	0	0	*	2	3

MANDATORY COURSES II

SEMESTER – III									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH

1	MC	GGE51021	Traditional Indian Systems of Medicine and Therapies	3	0	0	*	2	3
2	MC	GGE51022	History of Science and Technology in India	3	0	0	*	2	3
3	MC	GGE51023	Political and Economic Thought for a Humane Society	3	0	0	*	2	3
4	MC	GGE51024	State, Nation-Building and Politics in India	3	0	0	*	2	3
5	MC	GGE51025	Industrial Safety	3	0	0	*	2	3

MANDATORY COURSES III

SEMESTER – IV									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	MC	GGE51031	Principles of Management	3	0	0	*	2	3
2	MC	GGE51032	Human Resource Management	3	0	0	*	2	3
3	MC	GGE51033	Green Technology	3	0	0	*	2	3
4	MC	GGE51034	Industrial Management	3	0	0	*	2	3
5	MC	GGE51035	Fintech and Financing new Business	3	0	0	*	2	3

MANDATORY COURSES IV

SEMESTER – VI									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	MC	ETP51854	Profesional Skill and Ethics	0	0	3	*	2	3

*Non Credit Course

DEPARTMENTAL ELECTIVES

VERTICAL 1: ELECTRIC VEHICLE TECHNOLOGY									
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
3	DE	EAT51500	Electric Drives and Control	2	0	2	3	2	4

OR									
3	DE	EAT51501	Policy for E-Mobility	2	0	2	3	2	4
4	DE	EAT51508	Battery Technology	2	0	2	3	2	4
OR									
4	DE	EAT51509	Electric and Hybrid vehicles	2	0	2	3	2	4
5	DE	EAT51516	Charging Technology	2	0	2	3	2	4
OR									
5	DE	EAT51517	Power Electronics for EV	2	0	2	3	2	4
6	DE	EAT51524	Modelling and Simulation of EV	2	0	2	3	2	4
OR									
6	DE	EAT51525	Coding for EV	2	0	2	3	2	4
7	DE	EAT51532	Computer Architecture and Data Analytics	2	0	2	3	2	4
OR									
7	DE	EAT51533	Smart Grid for EV	2	0	2	3	2	4

VERTICAL 2: INTELLIGENT MOBILITY									
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
3	DE	EAT51502	Instrumentation for Intelligent Mobility	2	0	2	3	2	4
OR									
3	DE	EAT51503	Intelligent Transportation system	2	0	2	3	2	4
4	DE	EAT51510	Advanced Driver Assistance System	2	0	2	3	2	4
OR									
4	DE	EAT51511	V2V and V2X Technology	2	0	2	3	2	4
5	DE	EAT51518	ECU Model Based System Design	2	0	2	3	2	4
OR									
5	DE	EAT51519	Cyber security for Automotive Engineers	2	0	2	3	2	4

6	DE	EAT51526	Automotive Safety Systems	2	0	2	3	2	4
OR									
6	DE	EAT51527	Automotive Electronic Management System	2	0	2	3	2	4
7	DE	EAT51534	Self-Driving Cars	2	0	2	3	2	4
OR									
7	DE	EAT51535	Pose estimation and state estimation of self-driving cars	2	0	2	3	2	4

VERTICAL 3: ENGINE AND VEHICLE TECHNOLOGY									
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
3	DE	EAT51504	Alternative Fuels and Energy Systems	2	0	2	3	2	4
OR									
3	DE	EAT51505	Vehicle body engineering	2	0	2	3	2	4
4	DE	EAT51512	Automotive Pollution and Control	2	0	2	3	2	4
OR									
4	DE	EAT51513	Off Road Vehicles	2	0	2	3	2	4
5	DE	EAT51520	Vehicle Design Data Characteristics	2	0	2	3	2	4
OR									
5	DE	EAT51521	Design of Engine Exhaust system	2	0	2	3	2	4
6	DE	EAT51528	Renewable Source of Energy	2	0	2	3	2	4
OR									
6	DE	EAT51529	Automotive Heating Ventilation Air Conditioning (HVAC)	2	0	2	3	2	4
7	DE	EAT51536	Vibration and Noise Control	2	0	2	3	2	4
OR									
7	DE	EAT51537	Fuel Cell Technology	2	0	2	3	2	4

VERTICAL 4: DESIGN AND MANUFACTURING									
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
3	DE	EAT51506	Production Technology	2	0	2	3	2	4
OR									
3	DE	EAT51507	Product Design and Development	2	0	2	3	2	4
4	DE	EAT51514	Computer Integrated Manufacturing	2	0	2	3	2	4
OR									
4	DE	EAT51515	Process Planning and Cost Estimation	2	0	2	3	2	4
5	DE	EAT51522	Digital Manufacturing	2	0	2	3	2	4
OR									
5	DE	EAT51523	Industrial Automation and Robotics	2	0	2	3	2	4
6	DE	EAT51530	Design of Experiments	2	0	2	3	2	4
OR									
6	DE	EAT51531	Industrial Engineering and Management	2	0	2	3	2	4
7	DE	EAT51538	Computational Fluid Dynamics	2	0	2	3	2	4
OR									
7	DE	EAT51539	Lean Manufacturing and Six sigma	2	0	2	3	2	4

NON-DEPARTMENTAL ELECTIVES

Non-Department Elective-1									
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
4	NE	EAT51700	Automotive Vehicle Technology	2	0	2	3	2	4
4	NE	EAT51701	Elements of Motorsports Engineering	2	0	2	3	2	4
4	NE	EAT51702	Energy from Renewable Sources	2	0	2	3	2	4
4	NE	EAT51703	Future Fuels for IC Engines	2	0	2	3	2	4

Non-Department Elective-2									
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
5	NE	EAT51704	Smart Materials for Automotive Applications	2	0	2	3	2	4
5	NE	EAT51705	Industrial Safety and Hazard Management	2	0	2	3	2	4
5	NE	EAT51706	Hydrogen Engine Technology	2	0	2	3	2	4
5	NE	EAT51707	E-Mobility: Policy & Business	2	0	2	3	2	4

Non-Department Elective-3									
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
6	NE	EAT51708	Automotive Safety Systems	2	0	2	3	2	4
6	NE	EAT51709	Introduction to Intelligent Transport Systems	2	0	2	3	2	4
6	NE	EAT51710	Fuel Cell Technology	2	0	2	3	2	4
6	NE	EAT51711	Sensor Technology & Sensor Fusion for Autonomous Car	2	0	2	3	2	4

Non-Department Elective-4									
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
7	NE	EAT51712	Plant Layout and Material Handling	2	0	2	3	2	4
7	NE	EAT51713	Electric Vehicle Technology-Two and Three-Wheeler	2	0	2	3	2	4
7	NE	EAT51714	Introduction to Self- Driving Cars	2	0	2	3	2	4
7	NE	EAT51715	Automotive Air-conditioning and Climate Control.	2	0	2	3	2	4

HONORS COURSES OFFERED BY THE DEPARTMENT

1. LIST OF COURSES UNDER THE HONORS IN MOTORSPORT ENGINEERING:

SEMESTER - V									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1.	HN	EAT51900	Race Car Anatomy	3	0	0	3	1	3
SEMESTER - VI									
2.	HN	EAT51901	Motorsport Vehicle System Design	3	0	0	3	1	3
SEMESTER - VII									
3.	HN	EAT51902	Aerodynamics for Race Cars	3	0	0	3	1	3
4.	HN	EAT51903	Racetrack and Data Management	3	0	0	3	1	3
Total Credits							12		

2. LIST OF COURSES UNDER THE HONOURS IN AUTOTRONICS:

SEMESTER - V									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1.	HN	EAT51904	Perception System for Autonomous Car	3	0	0	3	1	3
SEMESTER - VI									
2.	HN	EAT51905	Intelligent Transport system and V2V technology	3	0	0	3	1	3
SEMESTER - VII									
3.	HN	EAT51906	Pose Estimation for Autonomous Car	3	0	0	3	1	3
4.	HN	EAT51907	State Estimation and Vehicle control for Autonomous Car	3	0	0	3	1	3
Total Credits							12		

3. LIST OF COURSES UNDER THE HONORS IN ELECTRIC VEHICLES AND E- MOBILITY:

SEMESTER - V									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1.	HN	EAT51908	Hybrid Vehicles	3	0	0	3	1	3
SEMESTER - VI									

2.	HN	EAT51909	Battery Technology and Management	3	0	0	3	1	3
SEMESTER - VII									
3.	HN	EAT51910	Advanced Propulsion System for Electric Drive Vehicles	3	0	0	3	1	3
4.	HN	EAT51911	Energy Storage Devices and Systems	3	0	0	3	1	3
Total Credits							12		

Semester	Credits	S. No.	Category Code	Category	Breakup of Credits	COURSE TYPE	
I	22	1	HS	Humanities & Social Science Courses	16	TP	Theory with Practical Course
II	22	2	BS	Basic Science Courses	24	TH	Theory Course
III	22	3	ES	Engineering Science Courses	19	PR	Practical Course
IV	22	4	PC	Programme Core Courses	57	DP	Design Project
V	21	5	DE	Department Elective Courses	15	PJ	Project
VI	21	6	NE	Non Department Elective Courses	12	IN	Internship
VII	22	7	EEC	Employment Enhancement Courses	22		
VIII	13	8	MC	Mandatory Courses	*		
Total	165	TOTAL			165		
		9	HN	Honors Courses	12		
		10	MN	Minors Courses	9		

SYLLABUS
SEMESTER - I

COURSE TITLE		MATRICES AND CALCULUS (Common to ALL B. Tech)						CREDITS				4		
COURSE CODE		EMA51001		COURSE CATEGORY				BS		L-T-P-S		3-0-2-2		
Version		1.0		Approval Details		36 th ACM		LEARNING LEVEL				BTL-3		
ASSESSMENT SCHEME														
CIA										ESE				
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)			Practical Assessments		Observation / Lab records as approved by the Department Examination Committee “DEC”		Attendance		End Semester Examination (Theory)		End Semester Examination (Practical)		
15%	15%			10%		5%		5%		25%		25%		
Course Description	To make the student understand the basic concepts of matrices and calculus using MATLAB													
Course Objective	1. To perform some simple operations on matrices 2. To give a strong foundation on the basic concepts of differentiation and integration. 3. To demonstrate the fundamental understanding of integrals 4. To classify ordinary differential equations. 5. To impart the knowledge of sequences and summation of series.													
Course Outcome	Upon completion of this course, the students will be able to 1. Calculate the inverse of the matrix using Cayley Hamilton theorem and diagonalize the matrix 2. Determine the derivative and higher derivatives of a given function explicitly and integrate the standard functions using suitable differentiation and integration formulae 3. Evaluate surface area and volume using multiple integrals 4. Compute the solution of second order the differential equations 5. Determine the convergence and divergence of the sequence using the appropriate tests.													
Prerequisites: Knowledge in calculus at high secondary level.														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PS O-2
CO-1	3	3	1	2	2	-	-	-	-	-	-	1	2	1
CO-2	2	3	2	1	1	-	-	-	-	-	-	1	1	2
CO-3	3	2	1	2	2	-	-	-	-	-	-	2	2	1
CO-4	3	2	2	1	1	-	-	-	-	-	-	2	1	2
CO-5	3	3	2	1	2	-	-	-	-	-	-	1	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: MATRICES (9L+6P)														

Characteristic equation – Eigen values and Eigenvectors – Properties – Cayley Hamilton theorem (Statement only) – Verification and inverse of the matrix using Cayley Hamilton theorem-Diagonalization of matrices using similarity transformation Suggested Reading: Basics of Matrices Lab: Eigen values and Eigenvectors, Verification and inverse using Cayley Hamilton theorem-Diagonalization		CO-1 BTL-3
MODULE 2: DIFFERENTIAL AND INTEGRAL CALCULUS		(9L+6P)
Basic Concepts and Simple Problems in Differentiation and Integration-Partial differentiation – Total differentiation- Taylor’s series – Maxima and minima of functions of two variables. Integration – Methods of integration – Substitution method – Integration by parts – Integration using partial fraction – Bernoulli’s formula. Suggested Reading: Basics of differentiation and integration. Lab: Taylor’s series – Maxima and minima of functions of two variables, Integration using partial fraction		CO-2 BTL-3
MODULE 3: MULTIPLE INTEGRAL		(9L+6P)
Double integration – Cartesian and polar co-ordinates – Change of order of integration. Area as a double integral – Triple integration in Cartesian coordinates – Volume as a triple integral - Change of variables between Cartesian and polar coordinates. Suggested Reading: Line Integrals Lab: Area and Volume of double integration and triple integration.		CO-3 BTL-3
MODULE 4: ORDINARY DIFFERENTIAL EQUATIONS		(9L+6P)
Second order differential equations with constant coefficients – Particular integrals – e^{ax} , $\cos ax$, $\sin ax$, x^m , $e^{ax} \cos bx$, $e^{ax} \sin bx$, Solutions of homogeneous differential equations with variable coefficients – Variation of parameters. Suggested Reading: Basics of Differential Equations. Lab: Solution of Second order differential equations.		CO-4 BTL-3
MODULE 5: SEQUENCE AND SERIES		(9L+6P)
Definition of Sequence and series with examples, Convergence, divergence and Oscillation of sequence and series, properties, Tests for convergence of series (Comparison test, Limit Comparison test, Integral test, Ratio test, D’ Alembert’s test, Alternating Series). Suggested Reading: Basics of sequence and series. Lab: Test the convergence and divergence.		CO-5 BTL-3
TEXT BOOKS		
1.	A. Chandrasekaran, G Kavitha (2019), <i>Matrices and Calculus</i> , Dhanam Publications, 1 st Edition, Chennai.	
2.	B.S. Grewal (2017), <i>Higher Engineering Mathematics</i> , Khanna Publishers, 43 rd Edition, New Delhi.	
3.	A. P. Santhakumaran, P. Titus P (2017), <i>Engineering Mathematics – II</i> , NiMeric Publications, 2 nd Edition, Nagercoil, India.	
REFERENCE BOOKS		
1.	D. G. Duffy (2021), <i>Advanced Engineering Mathematics with MATLAB (Advances in Applied Mathematics)</i> , Chapman and Hall Publisher, 5 th Edition, CRC Press, USA.	
2.	M. D. Weir, Joel Hass, Thomas (2016), <i>Calculus</i> , Pearson Publication, 12 th Edition, India.	
3.	Srimantha Pal and S.C. Bhunia (2015), <i>Engineering Mathematics</i> , Oxford University Press, 1 st Edition, New Delhi, India.	
E BOOKS		

1.	https://www.elsevier.com/books/matrix-calculus/bodewig/978-1-4832-3214-0
2.	https://www.ebooks.com/en-er/book/209983367/matrix-calculus-kronecker-product-and-tensor-product-a-practical-approach-to-linear-algebra-multilinear-algebra-and-tensor-calculus-with-software-implementations-third-edition/yorick-hardy/
MOOC	
1.	https://www.coursera.org/learn/introduction-to-calculus
2.	https://nptel.ac.in/courses/111105035

COURSE TITLE		ENGINEERING PHYSICS (Common to ALL branches of Engineering)			CREDITS	4
COURSE CODE		EPH51001	COURSE CATEGORY	BS	L-T-P-S	3-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL		BTL3
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination	
15%	15%	10%	5%	5%	Theory 25%	
					Practical 25%	
Course Description	This course is based on the developing areas of physics integrating both the theoretical and practical training for engineering students. Application of the concepts to solve engineering problems, to acquire practical thinking and logical reasoning.					
Course Objective	1. To evaluate various types of modulus of elasticity and impart knowledge on production and application of ultrasonic wave in SONAR and NDT. 2. To provide a strong foundation on the concepts of crystal physics and thermal conductivity. 3. To illustrate theoretically and experimentally the wave – particle duality. 4. To evaluate the material properties based on energy band gap and magnetic moment. 5. To make the students understand the production of lasers and propagation of light through an optical fiber.					
Course Outcome	Upon completion of this course, the students will be able to 1. Evaluate the elastic properties of materials and apply the properties of ultrasonic waves for industrial applications 2. Evaluate the characteristics of crystal structure and the thermal conductivity of good and bad conductors. 3. Solve the Schrodinger’s wave equations and derive energy density based on Planck’s hypothesis 4. Apply the fundamental concepts to classify magnetic and semiconducting materials and thereby, illustrate their applications.					

5. Apply lasers and optical fibers as engineering tools														
Prerequisites: Knowledge in fundamentals of Physics at higher secondary level														
CO, PO AND PSO MAPPING														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	1	1	-	-	-	2	-	-	2	1	2
CO2	3	3	2	2	3	-	-	-	3	-	-	3	2	1
CO3	3	3	1	1	1	-	-	-	2	-	-	2	1	2
CO4	3	3	1	2	1	-	-	-	3	-	-	1	1	3
CO5	3	3	2	1	3	-	-	-	3	-	-	3	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: PROPERTIES OF MATTER AND ULTRASONICS													(9L + 6P)	
Elasticity – Hooke’s law – Elastic Moduli – Young’s modulus of elasticity – Rigidity modulus - Bulk modulus – Twisting couple on a wire – Torsional pendulum – Determination of rigidity modulus of a wire – Depression of a cantilever – Non-uniform bending – Uniform bending – I shape girder. Introduction – Production of ultrasonic waves (Magnetostriction and Piezoelectric methods) – Properties of ultrasonic – Applications in SONAR and NDT. Practical component: Torsional pendulum – Determination of rigidity modulus of thin wire and moment of inertia of regular objects Non-uniform bending – Determination of Young’s modulus of wooden beam													CO1 BTL3	
MODULE 2: CRYSTALLOGRAPHY AND THERMAL PHYSICS													(9L + 6P)	
Amorphous and crystalline solids – Unit cell – Lattice parameters – Crystal system and Bravais lattices (Qualitative) – Miller indices – Interplanar spacing for cubic crystal system – Crystal structures SCC, BCC, FCC, HCP (no. of atoms, coordination number, atomic packing fraction calculations) – Bragg’s law – X-ray diffractometer. Thermal conductivity – Experimental determination of thermal conductivities of good and bad conductors – Forbe’s method (Theory and experiment) – Lee’s disc method for bad conductors. Practical component: Lee’s disc experiment – Determination of thermal conductivity of bad conductor													CO2 BTL3	
MODULE 3: QUANTUM PHYSICS													(9L + 6P)	
Black body radiation – Planck’s hypothesis – Photoelectric effect – Compton effect – Theory and experimental verification Physical significance of wave function – Schrodinger’s wave equation – Time independent and time dependent equations – Particle in a 1D box – Quantum Well (no derivation) Practical component: Photoelectric effect – To plot the KE as a function of frequency for different metals.													CO3 BTL3	
MODULE 4: MAGNETISM AND SEMICONDUCTORS													(9L + 6P)	
Magnetic moment – Classification of magnetic materials (Dia, para, ferro, anti-ferro) – Domain theory of ferromagnetism – Hysteresis – Hard and soft magnetic materials – Memory applications. Classification of semiconductors – Direct and in-direct bandgap – Fermi energy level – Intrinsic and extrinsic semiconductors – <i>n</i> -type and <i>p</i> -type semiconductors (Qualitative) – Hall effect – Determination of Hall voltage (Theory and experiment) – Applications of Hall effect. Practical component:													CO4 BTL3	

Current – Voltage (IV) characteristics of semiconductor diode		
MODULE 5: MODERN OPTICS		(9L + 6P)
Principles of laser – Stimulated absorption – Spontaneous emission – Stimulated emission – Population inversion – Pumping action – Active medium – Laser characteristics – Nd-YAG laser – CO ₂ laser – Dye laser – Laser in Industrial applications. Optical fiber – Principle and propagation of light in optical fibers – Numerical aperture and acceptance angle – Types of optical fibers – Optical fiber as temperature sensors. Practical component: Laser – Determination of the wavelength of the laser using grating Laser – Particle size determination using lycopodium powder		CO5 BTL3
TEXT BOOKS		
1	Rajendran V. (2017), <i>Engineering Physics</i> , Tata McGraw Hill Publications, 3 rd Edition, US.	
2	Gaur R. K. and Gupta S.L. (2014). <i>Engineering Physics</i> , 8 th edition, Dhanpat Rai publications (P) Ltd., New Delhi	
3	Mani P. (2016), <i>Engineering Physics</i> , Dhanam Publications, 13 th Edition, Chennai.	
REFERENCE BOOKS		
1.	Arthur Beiser (2017), <i>Concepts of Modern Physics</i> , Tata McGraw Hill Publications, 7 th Edition, US.	
2.	Halliday, Resnick and Walker (2021), <i>Fundamental of Physics Extended</i> , Wiley & Sons, 12 th Edition, US.	
3	Shaikh I. A, Kulkarni H. R, Mohril, S. F. and Khairnar (2018), <i>Engineering Physics</i> , Nirali Prakashan Publishers, 5 th Edition, Pune.	
E BOOKS		
1.	https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/042-Fundamentals-of-Physics-II-Electromagnetism-Optics-and-Quantum-Mechanics-R.-Shankar-Edisi-1-2016.pdf	
2.	https://zenodo.org/record/243407#.YOefilxBzIU	
3.	https://salmanisaleh.files.wordpress.com/2019/02/physics-for-scientists-7th-ed.pdf	
MOOC		
1.	http://nptel.ac.in/courses/115106061	
2.	http://nptel.ac.in/courses/117101054/12	

COURSE TITLE	ENGINEERING MATERIALS (Common to ALL B.Tech.)			CREDITS	4
COURSE CODE	ECT51001	COURSE CATEGORY	BS	L-T-P-S	3-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE
15%	15%	10%	5%	5%	Theory 25%
					Practical 25%

Course Description	To expose the students to the basics of Engineering Materials and their applications.													
Course Objective	1. To make the students understand the basics of crystal structure and phase rule. 2. To provide a knowledge on the theoretical basis of the chemical composition, properties and applications of abrasives, adhesives, lubricants and refractories. 3. To give a strong foundation on the basic concepts of nanomaterials, the general synthetic methods with emphasis on their applications. 4. To provide an exposure on the fundamentals and applications of polymeric materials and composites. 5. To illustrate the applications of energy materials, liquid crystals and conducting polymers with a good exposure on their basic terminologies.													
Course Outcome	Upon completion of this course, the students will be able to 1. Propose and justify suitable metals/materials for alloying. 2. Distinguish and select a suitable material as abrasives / adhesives / lubricants / refractories based on its properties and applications. 3. Select an appropriate technique for nanomaterial synthesis and characterization. 4. State and select a suitable polymeric / composite material for industrial applications. 5. Develop the suitable organic/inorganic materials that can be employed in energy storage / production and electronic devices.													
Prerequisites: Knowledge in fundamentals of chemistry at higher secondary level.														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PSO-2
CO-1	3	2	2	-	-	-	1	-	-	-	-	1	1	2
CO-2	3	2	1	-	-	-	2	-	-	-	-	2	2	2
CO-3	3	2	2	-	-	-	1	-	-	-	-	3	1	1
CO-4	3	2	1	-	-	-	2	-	-	-	-	2	2	2
CO-5	3	2	1	-	-	-	2	-	-	-	-	2	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: CRYSTAL STRUCTURE AND PHASE RULE													(9L + 6P)	
Basic crystal systems – Types, characteristics, examples – Space lattice, Unit cell – types – X-ray diffraction and crystal structure. Phase rule: Basic terminology - Derivation of Gibbs Phase rule- Phase diagrams: One component system (water), Two component system – Reduced phase rule: Simple Eutectic system, examples, Phase diagram: Ag-Pb system, Pb-Sn system – Applications of phase rule. Practical components: Construction of phenol-water phase diagram - Determination of apparent density of porous solids.													CO-1 BTL-3	
MODULE 2: ABRASIVES, ADHESIVES, LUBRICANTS AND REFRACTORIES													(9L + 6P)	
Abrasives – Classification, Properties, Uses – Adhesives – Development of Adhesive strength, Physical and Chemical factors influencing adhesive action, Classification of Adhesives – Epoxy Resin (Preparation, Properties and Applications) – Lubricants – Mechanism of Lubrication, Classification and Properties, Semi Solid Lubricants, Solid Lubricants, MoS₂ and Graphite - Refractories – Classification, Properties, Applications. Practical components: Preparation of urea-formaldehyde resin - Determination of porosity of a refractory													CO-2 BTL-3	

MODULE 3: NANOMATERIALS		(9L + 6P)
Introduction – Scope of nanomaterials - Types of nanomaterials - Synthesis of Nanomaterials - Bottom-up and Top-down approaches – Methods of preparation – Laser ablation, Sol-gel process, Gas-phase condensation, Chemical Vapour Deposition. Properties – Optical, Electrical, Magnetic, Chemical properties (introduction only). Characterization – UV-Visible spectroscopy, FE-SEM and TEM (Principle and Applications only). Practical components: Preparation of ZnO nanoparticles by wet chemical method – Verification of Beer-Lambert’s law using silver nanoparticles.		CO-3 BTL-3
MODULE 4: POLYMERS AND COMPOSITES		(9L + 6P)
Introduction – Basic definitions – Classification of polymers – Structure and property relationship of polymers – Plastics – Synthesis, properties and applications of polycarbonates and phenol-formaldehyde - Biodegradable Polymers, examples and applications. Composites - Introduction - Definition – Constituents – Classification - Fiber-reinforced Composites –Types and Applications. Practical components: Determination of molecular weight / viscosity of polymer using Ostwald Viscometer.		CO-4 BTL-3
MODULE 5: MATERIALS FOR ENERGY AND ELECTRONIC APPLICATIONS		(9L + 6P)
Energy storage materials – Metal-hydride batteries, Li-batteries - Materials for solar cells: Semi-conductors - Materials for hydrogen technology - production (electrolysis), storage (hydrides), fuel cells. Liquid Crystals - Introduction –Characteristics – Optical properties- Classification – Chemical constitution and liquid crystalline behaviour - Applications. Conducting Polymers: Classification, Intrinsic Conducting Polymers, Extrinsic Conducting Polymers, Applications. Practical components: Preparation of polyaniline / Polypyrrole.		CO-5 BTL-3
TEXT BOOKS		
1.	Jain, P.C., Jain, M. (2018). <i>Engineering Chemistry</i> , Dhanpat Raj Publishing Company (P) Ltd, New Delhi, 17 th Edition.	
2.	Puri, B. R., Sharma, L. R., Pathania, M. S. (2020). <i>Principles of Physical Chemistry</i> , Vishal Publishing Co. Jalandhar, 47 th Edition.	
3.	Rangwala. (2017). <i>Engineering Materials</i> , Charotar Publishing House Pvt. Ltd, 43 rd Edition.	
REFERENCE BOOKS		
1.	Clyne, T. W., Hull, D. (2019). <i>An introduction to composite materials</i> , Cambridge University Press, 3 rd Edition.	
2.	Shah, M. A., Ahmad, T. (2021). <i>Nano Science & Technology</i> , Dreamtech Press, 2021 Edition.	
3.	Palanna, O. G. (2018). <i>Engineering Chemistry</i> , Mc Graw Hill Education (India) Pvt. Ltd, 2 nd Edition.	
E BOOKS		
1.	http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html	
2.	https://abmpk.files.wordpress.com/2014/02/book_maretil-science-callister.pdf`	
MOOC		
1.	https://www.edx.org/course/materials-science-engineering-misix-mse1x	
2.	https://www.mooc-list.com/tags/materials-science	

COURSE TITLE		PROFESSIONAL COMMUNICATION				CREDITS		1						
COURSE CODE		GLS51018		COURSE CATEGORY		HS		L - T – P – S		3- 0 -0- 1				
Version	01	APPROVAL DETAILS		42 nd ACM, 26 th Oct. 2024				LEARNING LEVEL		BTL 4				
ASSESSMENT SCHEME														
Continuous Internal Assessment (CIA)										ESE				
First Periodical Assessment	Second Periodical Assessment	Weekly assignment as approved by the Department Examination Committee “DEC”			Surprise Test / Quiz., as approved by the Department Examination Committee “DEC”			Attendance		Theory				
15 %	15 %	10 %			5 %			5 %		50 %				
Course Description		The Communication Skills course is designed to enhance students' proficiency in verbal and written communication, with a strong emphasis on developing accurate and grammatically correct language usage. The focus is on grammar exercises, and practical application, students will learn to articulate ideas clearly while adhering to proper English syntax and conventions. The course covers essential aspects such as grammar review and practice, vocabulary building, pronunciation and articulation, writing skills, speaking practice, and error analysis and feedback, aiming to improve students' accuracy in language usage and enable them to communicate effectively in academic, professional, and social contexts.												
Course Objective		1. The course aims to enhance students' proficiency in verbal and written communication by improving their grammar usage and vocabulary. 2. It focuses on developing accurate and grammatically correct language usage through targeted grammar exercises and practical application. 3. Additionally, the course emphasizes the importance of pronunciation and articulation by practicing clear and effective communication. 4. Furthermore, it aims to improve students' writing skills by learning to write clearly and concisely in various forms of written communication. 5. By the end of the course, students will be able to communicate effectively and accurately in English for academic, professional, and social purposes.												
Course Outcome		Upon completion of this course, the students will be able to 1. Demonstrate the skills of framing simple sentences without grammatical errors. 2. Illustrate proficiency in using verb tenses, active and passive voice, and modal verbs accurately. 3. Apply their knowledge of future tenses, infinitives and gerunds, and conditionals to express hypothetical and real-life situations. 4. Make use of their knowledge of transforming, identifying, correcting and expressing to communicate accurately in various contexts. 5. Apply the knowledge of the different types of sentences in enhancing the clarity and coherence in their communication.												
Prerequisites: Plus Two English-Intermediate Level														
CO AND PO MAPPING														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	-	-	-	-	-	-	-	-	2	3	-	3	1	1
CO2	-	-	-	-	-	-	-	-	2	3	-	3	0	2
CO3	-	-	-	-	-	-	-	2	2	3	-	3	1	1

CO4	-	-	-	-	-	-	-	2	2	3	2	3	0	2
CO5	-	-	-	-	-	-	-	2	2	3	2	3	1	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 : Basics of Communication														(9L)
Grammar: Parts of Speech – Identification and Transformation – suffixes. Kinds of Sentences – Identification and Transformation. Sentence Pattern – Identifying and Framing Simple Sentences. Articles. Prepositions Vocabulary : Computer terms; email and website terms - Adverbs Denoting updates -Adjectives for Compound Noun Time Management Writing : Writing a Self Introduction - Writing letters as a student in an institution Reading : Introduction to Communication - Communication Process Lab : (Speaking) : Self Introduction (Listening) : Various Self Introductions														CO-1 BTL-2
MODULE 2 : Time Expressions														(9L)
Grammar: Tenses: Introduction to verbs - Types, Forms ; regular and irregular verbs. Tenses – Rules and its usage – Present tenses: simple present, present continuous, present perfect, present perfect continuous - Past tenses: simple past, past continuous, past perfect, past perfect continuous. – Time expressions Vocabulary : Verbs to Describe process - Vocabulary to talk about advertising and marketing. Writing : Topic Sentence - Paragraph Writing - Writing an essay Reading: Verbal & Nonverbal Communication - Types of Communication - Barriers in Communication Lab: Practicum(Speaking) : A Discussion on the impact of technology on human life. (Listening) : Talks on Technology														CO-2 BTL-2
MODULE 3 : Expressing the Future														(9L)
Grammar: Future Tenses : simple future , future continuous, future perfect, future perfect continuous - Active and Passive Voice – Identifying the voices and Transforming Active to passive and passive to active - Modal Verbs to express modalities: in active and passive voices Vocabulary : Vocabulary for travel - Synonyms and Antonyms Writing: A letter(Email) of invitation – Accepting the invitation and declining the invitation - Writing a Product description Reading : Past and Present Technologies - The future of Technology: predictions. Lab : (Speaking): A Discussion on the future plans. (Listening): Describing a product														CO-3 BTL-3
MODULE 4 : Contextualizing														(9L)
Grammar: Infinitives and gerunds – using infinitives and gerunds in sentences as different elements. - Conditionals – Three types of conditionals 3. Instructions and Recommendations – Transforming instruction to recommendation and recommendation to instruction Vocabulary : Affixes - Global Management - Reporting Verbs Writing : Writing a user manual - Email : Requesting information Reading : .Barriers in Communication - Global Warming Lab : (Speaking): Role Play : Interviewing someone about a job change (Listening) Job Interviews														CO-4 BTL-3
MODULE 5 : Clarity and Coherence														(9L)
Grammar : Concord: Identifying the error and Correcting the errors - Adjectives: Degrees of Comparison - Discourse Markers : application of discourse markers in the sentences. Vocabulary : Describing Trends - Finance Vocabulary - Phrasal Verbs Writing: Writing an Argumentative essay - Summary writing Reading : Describing Statistics - Company finances, investments and starting up Lab : (Speaking) : Discussing qualities needed in candidates for a job vacancy (Listening) Tips to enhance the employability skills														CO-5 BTL-4
TEXT BOOK														
1	Doff, A., Thaine, C., Puchta, H., Stranks, J., & Lewis-Jones, P. (2023). <i>Empower Second Edition</i> . Cambridge University Press & Assessment. New Delhi.													
REFERENCE BOOKS														
1.	Murphy, Raymond.(2021). <i>Essential English Grammar</i> , Cambridge University Press. India (Pages 300)													
2.	Redman, Stuart.(2020). <i>English Vocabulary In Use: Pre - Intermediate And Intermediate</i> . Cambridge University Press. India (Pages 264)													

3.	Bikram K. Das. et al.,(2019) <i>An Introduction to Professional English and Soft Skills with audio CD</i> , Cambridge University Press. India (Pages 272)
4.	John, Dolly., (2018), <i>English for Life and the Workplace Through LSRW&T Skills</i> , Pearson Publications.India (Pages 263)
E BOOKS	
1.	https://www.cambridge.org/gb/files/9116/4138/4615/A1_Student_Book.pdf
2.	https://www.cambridge.org/gb/files/1416/4138/4681/A1_Workbook.pdf
3.	https://www.cambridge.org/gb/files/7216/4138/1999/A2_Student_Book.pdf
4.	https://www.cambridge.org/gb/files/6816/4138/2072/A2_Workbook.pdf
MOOC	
1.	https://www.edx.org/professional-certificate/tsinghuax-english-communication-skills
2.	https://www.britishcouncil.org/tr/en/english/mooc/english-for-the-workplace

COURSE TITLE	PROGRAMMING FUNDAMENTALS USING C			CREDITS	3	
COURSE CODE	ECS51009	COURSE CATEGORY	ES	L-T-P-S	2- 0- 2- 2	
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-5	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	To introduce computers and programming in C and also explore the power of computational techniques that are currently used by engineers and scientists and to develop programming skills with reasonable complexity.					
Course Objective	1. To acquire the basic knowledge in computer hardware, programming languages and Problem-solving techniques. 2. To learn the fundamentals of C programming. 3. To gain knowledge in Functions, arrays and strings in C programming. 4. To understand the pointers, Structures and Union in C programming 5. To gain knowledge on Embedded Programming and real time applications of C Programming.					
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the basics of digital computer and programming languages. 2. Demonstrate problem solving techniques using flowchart, algorithm/pseudo code to solve the given problem. 3. Design and Implement C program using Control Statements and Functions. 4. Design and Implement C program using Pointers and File operations. 5. Identify the need for embedded C and C Programming in real-time applications.					
Prerequisites: Nil						

CO, PO AND PSO MAPPING														
CO	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO- 1	PSO- 2
CO-1	2	2	2	-	-	2	-	2	-	-	1	2	2	1
CO-2	3	3	3	2	2	1	-	2	2	1	-	1	1	2
CO-3	3	3	3	2	2	2	-	1	3	3	2	1	2	1
CO-4	3	3	3	2	-	-	-	-	-	-	1	-	2	2
CO-5	1	1	1	-	1	2	-	1	-	-	-	2	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: PROGRAMMING LANGUAGES AND PROBLEM-SOLVING TECHNIQUES													(6L+ 6P)	
Introduction – Fundamentals of digital computers - Programming languages -Programming Paradigms – Types of Programming Languages – Language Translators – Problem Solving Techniques: Algorithm – Flow Chart - Pseudo code. Practical Component Draw Flowcharts using E- Chart & Write pseudo code for the following problems 1. Greatest of three numbers 2. Sum of N numbers 3.Computation of nCr Software Required: GCC Suggested Readings: https://www.simplilearn.com/tutorials/programming-tutorial/problem-solving-in-programming													CO-1 BTL-4	
MODULE 2: FUNDAMENTALS OF C													(6 L+ 6 P)	
Evolution of C -Why C language - Applications of C language - Data Types in C – Operators and Expressions – Input and Output statements in C – Decision Statements – Loop Control Statements. Practical Component 1. Program to illustrate arithmetic and logical operators 2. Program to read and print data of different types 3. Program to calculate area and volume of various geometrical shapes 4. Program to compute biggest of three numbers 5. Program to print multiplication table 6. Program to convert days to years, months and days 7.Program to find sum of the digits of an integer Software Required: GCC Suggested Readings: https://www.w3schools.com/c/c_intro.php													CO-2 BTL-4	
MODULE 3: FUNCTIONS, ARRAYS, STRINGS													(6 L+ 6 P)	
Functions – Storage Class – Arrays – Strings and standard functions - Pre-processor Statements. Practical Component: 1. Program to compute Factorial, Fibonacci series and sum of n numbers using recursion 2. Program to compute sum and average of N Numbers stored in an array 3. Program to sort the given n numbers stored in an array 4. Program to search for the given element in an array 5. Program to do word count 6. Program to insert a substring in a string 7. Program to concatenate and compare two strings 8.Program using pre-processor statements Software Required: GCC Suggested Readings: https://cppguide.readthedocs.io/en/latest/cpp/array.html													CO-3 BTL-4	
MODULE 4: POINTERS, STRUCTURES AND UNION													(6 L+ 6 P)	

Pointers – Dynamic Memory allocation – Structure and Union – Files. Practical Component 1. Program to compute sum of integers stored in a 1-D array using pointers and dynamic memory allocation 2. Program to read and print records of a student/payroll database using structures 3. Program to simulate file copy 4. Program to illustrate sequential access file 5. Program to illustrate random access file Software Required: GCC Suggested Readings: https://www.ibm.com/docs/en/zos/2.4.0?topic=types-structures-unions		CO-4 BTL-4
MODULE 5: APPLICATIONS OF C		(6L+ 6P)
Structure of embedded C program - Data Types - Operators - Statements - Functions - Keil C Compiler. Game development using c - Analysing the environment - Snake game - Tic-Tac-Toe - flappy bird. Practical component: Simple programs using embedded C-Game Development using C Software Required: GCC Suggested Readings: https://www.interviewbit.com/blog/applications-of-c-programming-language/		CO-5 BTL-4
TEXT BOOKS		
1.	Ashok Kamthane, “Computer Programming”, Pearson Education, 7th Edition, Inc 2017.	
2.	Mark Siegesmund, "Embedded C Programming", first edition, Elsevier publications, 2014.	
3.	Robert Marmelstein, “Programming Games in C”	
REFERENCE BOOKS		
1.	Jeyapooan T, “Fundamentals of Computing and Programming in C”, Vikas Publishing house, 2015.	
2	Yashavant Kanetkar, “Let us C”, 15th edition, BPP publication, 2016.	
3	S. Sathyalakshmi, S.Dinakar, “Computer Programming Practicals – Computer Lab Manual”, Dhanam Publication, First Edition, July 2013.	
E BOOKS		
1.	https://en.wikibooks.org/wiki/C_Programming	
MOOC		
1.	https://onlinecourses.nptel.ac.in/noc18-cs10/preview	
2.	http://nptel.ac.in/courses/106105085/2	
3.	https://www.udemy.com/c-programming-for-beginners/	
4.	https://www.coursera.org/specializations/c-programming	

COURSE TITLE	PROGRAMMING IN PYTHON			CREDITS	3
COURSE CODE	ECS51010	COURSE CATEGORY	ES	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL- 5
ASSESSMENT SCHEME					
CIA				ESE	
First Periodical	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by	Attendance	Theory Practical

Assessment (Theory)	(Theory)		the Department Examination Committee “DEC”											
15%	15%	10%	5%	5%	25%	25%								
Course Description	Computer programming skills are now becoming part of basic education as these skills are increasingly of vital importance for future job and career prospects. The Python programming language which is one of the most popular programming languages worldwide. The course shows how to use the free open-source Python to write basic programs and high-level applications. This course is offered as a Theory Integrated Practical course by practicing Project Based Learning (PBL), emphasizing learning by doing, where the objective is to provide the students with the required hands-on exercises / projects that complements the theoretical understanding of the subject matters. The assessment is through the combination of written tests as well as practical through projects.													
Course Objective	The course should enable the students 1. To introduce basic concepts of Python programming language as well as common packages and libraries. 2. To generate an ability to design, analyze and perform experiments on real life problems using python.													
Course Outcome	Upon completion of this course, the students will be able to 1. Comprehend basic concepts in python. 2. Write python program to solve scientific, mathematical problems 3. Develop modular programs using functions and use data structures 4. Use toolboxes/ libraries and design simple algorithms using Python to solve real time applications													
Prerequisites:														
CO, PO AND PSO MAPPING														
CO - PO	PO -1	PO-2	PO- 3	PO- 4	PO-5	PO-6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	-	2	-	3	-	-	-	-	-	-	2	1	-
CO-2	3	3	3	-	3	-	-	-	-	-	-	2	-	1
CO-3	3	3	3	-	3	-	-	-	-	-	-	2	1	-
CO-4	3	3	3	3	3	-	-	1	2	2	2	2	-	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: PYTHON FUNDAMENTALS												(6L+ 6P)		
Introduction to python and its applications. Installation of Python and setting up a programming environment such as Anaconda and Spyder Python Basics: Variable and variable types, Booleans, Numbers: integers, floats, fractions, complex numbers, basic operators (arithmetic, relational, logical, membership, identity) Practical component: • Solve simple mathematical expressions using python • Perform type conversion Suggested Readings: • 10 Reasons to Learn Python Programming Language in 2022												CO-1 BTL-3		

Learning Python: From Zero to Hero		
MODULE 2: STRINGS, LISTS, TUPLES		(6L+ 6P)
Strings, lists, tuples, sets, dictionaries. bytes and byte arrays, manipulating variables, indexing, slicing, String methods, list methods, list slicing, set methods, in built python functions, input and output functions Practical component: - Perform string manipulation - Data sorting using lists - Write functions for data handling Suggested Readings: - Python programming for beginners		CO-2 BTL-5
MODULE 3: CONTROL STATEMENTS, LOOP AND FILE HANDLING		(6L+ 6P)
If, else, else if statements, for loops, range function, while loops, List comprehensions, functions in python. Introduction to OOP, Classes, Objects, Reading and writing files Practical component: - Write a python program using control statements - Develop objects and classes in python - Work with files for specific applications Suggested Readings: - Python programming for beginners		CO-2 BTL-5
MODULE 4: PYTHON LIBRARIES		(6L+ 6P)
Installing of different libraries, packages or modules. Basic concepts of the following libraries: NumPy, Matplotlib, Pandas, SciPy libraries Practical component: - Python programming using libraries Suggested Readings: - The Python Bible		CO-4 BTL-5
MODULE 5: CASE STUDIES		(6L+ 6P)
Case Studies using Python: - Solving a linear differential equation using SciKit and plotting the result in matplotlib. - Image processing and manipulation and auto detection of any object based on color. - Python programming for an Arduino/ Raspberry PI - Machine Learning application using python - Case study that uses Python to solve department specific problems. Practical component: - Mini Project / Case studies Suggested Readings: - Python at Netflix		CO-4 BTL- 5
TEXTBOOKS		
1	Dr. R. NageswaraRao (2018). <i>Core Python Programming</i> , Dreamtech Press, Second Edition	
2	M.T. Savaliya and R.K. Maurya (2018). <i>Programming through Python</i> , StarEdu Solutions	
REFERENCE BOOKS		
1	Python Crash Course: A Hands-On, Project-Based Introduction to Programming (2nd Edition)	
2	Head-First Python: A Brain-Friendly Guide (2nd Edition)	

E BOOKS	
1	https://devfreebooks.github.io/python/
MOOC	
1	"The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/

COURSE TITLE			ENGINEERING GRAPHICS AND COMPUTER AIDED DESIGN						CREDITS			3		
COURSE CODE			EME51001		COURSE CATEGORY			ES		L-T-P-S			2-0-2-2	
Version			1.0		Approval Details			36 th ACM		LEARNING LEVEL			BTL-3	
ASSESSMENT SCHEME														
First Periodical Assessment			Second Periodical Assessment		Weekly assignment/Observation / lab records and viva as approved by the DEC			Surprise Test/ Quiz etc., as approved by the DEC		Attendance			ESE (Theory + Practical)	
15%			15%		10%			5%		5%			25% + 25%	
Course Description			This course broadly introduces the mechanical design using computer aided design tools and fundamentals of free hand sketching. It prepares the students to learn the basic concepts involved in technical drawing and computer graphics. It also emphasis on the principles of projections and visualization of part drawing.											
Course Objective			1. To demonstrate the concepts of Engineering graphics and projection of straight lines using CAD software 2. To visualize the solids in various orientations and to draw its projections 3. To comprehend the concepts of isometric projections 4. To draw the development of solid surfaces and to generate associated views of civil drawings. 5. To visualize and draw views of the object by free hand sketch and to transform 3D models to 2D drawings using CAD tools											
Course Outcome			Upon completion of this course, the students will be able to 1. Demonstrate the concepts of Engineering graphics and projection of straight lines using CAD software. 2. Apply the acquired knowledge to solve simple problems of regular solids. 3. Create solid objects in isometric view using CAD software 4. Develop the simple solids and to sketch the plan and elevation of the building drawings. 5. Visualize the objects and to draw by free hand sketching.											
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO -1	PSO -2
CO-1	2	1	-	-	1	-	-	1	1	1	-	2	2	1

CO-2	2	1	-	-	2	-	-	1	1	2	-	2	1	-
CO-3	2	2	2	-	2	-	-	2	2	2	-	2	1	2
CO-4	3	2	2	-	3	-	-	2	2	2	-	2	1	-
CO-5	3	1	2	-	-	-	-	1	2	2	-	2	-	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: BASICS OF ENGINEERING GRAPHICS													(6L + 6P)	
Relevance of Graphics in Industry - BIS conventions and specifications - drawing sheet sizes - Lettering – Dimensioning - Scales. Drafting methods - Introduction to Computer Aided Drafting –Exposure to Solid Modelling software – Printer and Plotter – 3D printer. Introduction to Orthographic projections - Naming views as per BIS - First angle projection method. Projection of points and projection of Straight lines. <i>Suggested Reading: Solid modelling Software commands</i>													CO-1 BTL-2	
MODULE 2: PROJECTION OF SOLIDS													(6L + 6P)	
Projections of solids. Solids in simple positions and axis inclined to one plane only. Section of solids. Section planes inclined to Horizontal Plane only. True shape of the section. (Manual and CAD Drawing) <i>Suggested Reading: Solids inclined to both the planes. Section of solids with sectional planes inclined to VP.</i>													CO-2 BTL-2	
MODULE 3: ISOMETRIC PROJECTION													(6L + 6P)	
Concepts of isometric projection. Isometric scale, Isometric view of simple solids with sectional planes. (Manual and CAD Drawing) <i>Suggested Reading: Isometric view of solids with multiple sectional planes.</i>													CO-3 BTL-3	
MODULE 4: DEVELOPMENT OF SURFACES AND CIVIL DRAWING													(6L + 6P)	
Development of Surfaces of simple solids with simple sectional planes. Parallel line method and Radial line method only. (Manual and CAD Drawing) Civil Drawing: PLAN and ELEVATION of Simple residential building. (Manual and CAD Drawing) <i>Suggested Reading: Development of Sphere, Sectional elevation of building drawing</i>													CO-4 BTL-2	
MODULE 5: FREE HAND SKETCHING													(6L + 6P)	
Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three-Dimensional objects — Pictorial Projection methods - Layout of views- Conversion of pictorial views to orthographic view. <i>Suggested Reading: Orthographic views to pictorial views</i>													CO-5 BTL-3	
TEXT BOOKS														
1.	Jeyapoovan, T., Engineering Graphics and Design, Vikas Publishing House Pvt Ltd., New Delhi, 8 th Edition, 2022.													
2.	P. Kannaiah, K. L. Narayana, K. Venkata Reddy, A Textbook on Engineering Drawing, BS Pub, 2016.													
REFERENCE BOOKS														
1.	Alf Yarwood, Introduction to AutoCAD – 2D and 3D Design, Newnes Elsevier, 2011													
2.	Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2019.													
3.	Kirstie Plantenberg, Engineering Graphics Essentials, SDC Publications., fifth Edition, 2016.													

E - Books	
1.	https://www.amazon.in/Technical-Drawing-Engineering-Graphics-International-ebook/dp/B00IZ0FZHA
MOOC	
1.	http://nptel.ac.in/courses/112103019/
2.	https://nptel.ac.in/courses/112102304/

COURSE TITLE	DESIGN THINKING				CREDITS	3
COURSE CODE	EGE51002	COURSE CATEGORY		ES	L-T-P-S	2-0-2-2
Version	1.0	Approval Details		36 th ACM	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	<i>Design</i>, in a typical engineering context refers to the detailed plans & schemes developed through the application of best engineering practices for creating new products and systems. Design thinking, in this relevance, is the systematic methodology currently being adopted in industries and organizations for evolving optimal designs with innovative design approaches and strategies. In essence, it is truly about understanding a problem in an overall perspective taking into consideration of the customer needs, technology, businesses, environmental impact, safety and developing solutions. The design thinking methodology is essentially an iterative approach with cross-functional teams and adopted to wide ranging organizations right from engineering industries to service sectors. Hence this methodology is universal, holistic and non-domain centric. It opens a new world of problem-solving possibilities and helps the organizations to create new and innovative products, services, and processes.					

	The design thinking course offered at our university is well structured with good numbers of case studies and projects which makes the new and innovative concepts discussed in lecture hours get assimilated in the minds of students. This course is intentionally offered in the very first semester for all undergraduate engineering branches to make the students understand this new philosophy of the design thinking process and adopt the guidelines for their project works they take up in subsequent semesters including start-up projects.													
Course Objective	1. Inculcate the fundamental concepts of design thinking in students 2. Learn the different phases of design thinking 3. Use design thinking methods in every stage of the problem 4. Apply various methods of design thinking to different problems													
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the critical methods of design, systems thinking and key concepts of design thinking. 2. Understand the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices 3. Practice design thinking in all stages of problem solving. 4. Apply design thinking approach to real world problems 5. Conceive, organize, lead and implement projects in interdisciplinary domain and address social concerns with innovative approaches													
Prerequisites: NIL														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	1	1	2	1	2	2	2	1	1	-	2	1	1
CO-2	1	1	1	1	2	3	3	2	2	2	-	2	2	3
CO-3	1	1	2	1	2	3	3	2	3	3	2	2	3	3
CO-4	2	2	2	2	2	3	3	2	3	3	-	2	3	3
CO-5	2	1	2	2	2	3	3	2	3	3	2	2	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: INTRODUCTION													(6L + 6P)	
Design process: Traditional design, Design Requirements, Design approach and Strategies. Design Thinking Concept for Innovative Design - Breaking of patterns, Reframe existing design problems, Principles of creativity. Elements of Design Thinking - Design Thinking Phases: Empathize (Customer Needs), Define, Ideate, Prototype, Testing and Implementation. Design Thinking Frameworks. Design Thinking Team. Practical Case Studies: Enhancing the User Experience of a Digital Platform: Choose a popular digital platform or application and ask students to analyze its strengths and weaknesses from a user experience perspective. <i>Examples: Redesigning the platform's interface, functionality, or features to enhance usability, accessibility, and overall user satisfaction.</i>													CO-1 BTL-3	
MODULE 2: UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM													(6L + 6P)	

Search field determination - Problem clarification - Understanding of the problem – Problem analysis - Reformulation of the problem - Observation Phase - Empathetic design - Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs. Practical Case Studies: Redesigning a Medical Device: Focus on medical engineering by selecting a specific medical device or equipment used in healthcare settings. Students can explore opportunities to improve its functionality, ergonomics, ease of use, and patient experience through innovative design solutions. <i>Examples: (i) Hand held Blood Glucose Testing Machine (ii) Blood Pressure Monitor</i>	CO-2 BTL-3
MODULE 3: IDEATION (6L + 6P)	
Ideation Phase - The creative process and creative principles - Principles of Decomposition, Association, Analogy & Confrontation, Abstraction & Imagination. Guide team - Personas with wide range of professional experiences, stronger collaboration dynamics. Creativity techniques – Intuitive creative techniques – brainstorming, Systematic Analytical techniques - SWOT Analysis, The 5 Whys iterative interrogative technique - Valuation of ideas. Practical Case Studies: Redesigning an Educational Environment: Focus on improving the learning experience within a specific educational institution or classroom. Students can explore innovative design solutions that enhance collaboration, engagement, and personalized learning while considering factors such as classroom layout, educational technology, and accessibility. <i>Examples: (i) case study of Educational ERP (ii) Case study of Digital Learning Platform etc.</i>	CO-3 BTL-4
MODULE 4: PROTOTYPING AND VISUALIZATION (6L + 6P)	
Prototype Phase - Lean Startup Method for Prototype Development. Minimum Viable Product (MVP) – creation of MVPs, drawing and design models, wireframe, mockups, 3D Rapid prototyping. Visualization and presentation techniques. Visualization types – bar chart, pie chart, radar chart, mind mapping, affinity diagram, force field analysis, semantic differential (polarity analysis). Presentation Techniques – story telling, creative collages, design scenarios. Practical Case Studies: Designing an Eco-Friendly Packaging Solution: With a growing concern for environmental sustainability, challenge students to design an eco-friendly packaging solution for a consumer product. They can explore alternatives to single-use plastics, optimize packaging materials and design for efficient production, transportation, and disposal. <i>Examples: City Waste Segregation and consolidation Device (ii) Used Car Destruction and consolidation Device etc..</i>	CO-4 BTL-4
MODULE 5: TESTING AND IMPLEMENTATION (6L + 6P)	
Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking. Design Activism – Designing tomorrow. Entrepreneurship/business ideas. Technology Readiness Level (TRL) – 9 Levels. Practical Case Studies: Designing Assistive Technologies for People with Disabilities: Encourage students to develop innovative solutions to improve the quality of life for individuals with disabilities. They can focus on designing assistive technologies such as prosthetics, mobility aids, communication devices, or sensory enhancements to address specific challenges faced by this user group. <i>Examples: (i) Case study of patient assist mobile Robot (ii) Designing automated level control of overhead water tank etc.</i>	CO-5 BTL-4
TEXT BOOKS	

1.	Christian Mueller Roterberg, Handbook of Design Thinking, 2018.
2.	Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media Inc, 2017.
REFERENCE BOOKS	
1	Idris Mootee, "Design Thinking for Strategic Innovation", Wiley, 2013
2	Jeanne Liedtka and Tim Ogilvie, Designing for Growth: A design thinking tool kit for managers, Columbia university Press, 2011
3.	Hasso Plattner, Christoph Meinel and Larry Leifer, "Design Thinking: Understand – Improve – Apply", Springer, 2010
4	Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harper Collins, 2009
5	Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
E RESOURCES FOR REFERENCE	
1	https://www.design-thinking-association.org/explore-design-thinking-topics/design-thinking-case-studies
2	https://makeiterate.com/design-thinking-case-studies/
3	https://www.toptal.com/project-managers/digital/a-design-thinking-case-study
4	https://venturewell.org/class-exercises
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc19_mg60/preview
2.	https://onlinecourses.swayam2.ac.in/aic19_de02/preview

COURSE TITLE	ENGINEERING PRACTICES LAB (Common to All Branches)			CREDITS	2
COURSE CODE	EGE51406	COURSE CATEGORY	ES	L-T-P-S	0-0-4-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department	Attendance	ESE

						Examination Committee “DEC”								
15%			15%			10%		5%		5%		50%		
Course Description			This course is specifically designed to give the students a clear understanding of the mechanical engineering design and its process.											
Course Objective			The course should enable the students to 1. To Relate theory and practice of basic Mechanical and Civil Engineering. 2. To Learn basic concepts in Aeronautical and Automobile Engineering. 3. To Learn basic concepts in Electrical, Electronics, mechatronics and Computer Science.											
Course Outcome			Upon completion of this course, the students will be able to 1. Identify the tools, and types of joints used in welding, carpentry and plumbing. 2. Perform basic fabrication in welding, carpentry and plumbing, to make simple joints/connections. 3. Make simple electrical and electronic circuit connections, and may assemble the hardware of a desktop computer. 4. Demonstrate the working of a mechatronics systems like CNC machine, Robot, Pneumatic circuits. 5. Demonstrate the working of a 3D printer and list its applications.											
Prerequisites: NIL														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	-	2	-	1	-	-	-	-	-	-	2	1
CO-2	3	2	-	2	-	1	-	-	-	-	-	-	3	2
CO-3	3	2	-	2	-	1	-	-	-	-	-	-	2	1
CO-4	3	2	-	2	-	1	-	-	-	-	-	-	2	1
CO-5	3	2	-	2	-	1	-	-	-	-	-	-	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
LIST OF EXPERIMENTS with expected Learning outcome														
Exp. No.	Experiment Name												CO / BTL	
1	To Perform a Fillet/Groove weld in a Welding Simulator												CO 1 & BTL 3	
2	To Fabricate a Butt joint/Lap Joint using Arc Welding												CO 1 & BTL 3	
3	To make basic pipe connections in Plumbing using valves, couplings and elbows												CO 1 & BTL 3	
4	To make a common joint using Carpentry												CO 1 & BTL 3	
5	Assembling and Dismantling of a gasoline/Diesel Engine												CO 2 & BTL 3	
6	Measurement of Force using a spring balance												CO 2 & BTL 3	
7	To make an Electrical Wiring for extension box												CO 3 & BTL 3	
8	Study of Active and Passive Components												CO 3 & BTL 3	

9	To make simple circuit using Electronic Components	CO 3 & BTL 3
10	To Assemble a Desktop computer	CO 3 & BTL 3
11	To study the key elements of a Mechatronics system	CO 3 & BTL 3
12	Demo on linear actuator, using pneumatic circuit	CO 3 & BTL 3
13	Demo on Computerized Numerical Control (CNC) machine	CO 3 & BTL 3
14	Demo on a pick and place Robot	CO 3 & BTL 3
15	Demo on a 3D Printer	CO 3 & BTL 3
LIST OF EXPERIMENTS/TOOLS for 30 Students		
1	Welding Rectifier – 5 Nos	
2	Welding Simulator – 1 No.	
3	Two Stroke Gasoline Engine – 1 No.	
4	Spring balance – 5 Nos	
5	PVC Pipes and its accessories – 5 sets	
6	Saw, Planner, Chisel and its accessories – 5 sets	
7	Extension box and its accessories – 5 sets	
8	Electronic boards and its accessories – 5 sets	
9	Active components – 5 sets	
10	Passive components – 5 sets	
11	Desktop Computer – 5 Nos	
12	Linear Actuators and Pneumatic Kit– 1 Nos	
13	Rotary Actuators and Pneumatic Kit– 1 Nos	
14	CNC Machine – 1 No.	
15	6 Axis Robot – 1 No.	
16	3D Printer – 1 No.	
REFERENCE		
1	Jeyapoovan T and Saravanapandian M., (2015),Engineering practices lab manual, Vikas publishing House, New Delhi, 4th Edition.	
2	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K.,(2008), “Elements of Workshop Technology”, Vol.I ,Media promoters and publishers private limited, Mumbai.	
3	Ibrahim Zeid (2011), CAD/CAM Theory and Practice, Tata McGraw-Hill Publishing Company Ltd., New Delhi.	

COURSE TITLE	FAB LAB FOR CORE ENGINEERING (Auto, Bio-Tech, Civil, Mech and Mechatronics)			CREDITS	2
COURSE CODE	EGE51408	COURSE CATEGORY	ES	L-T-P-S	0-0-4-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					

First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	ESE									
15%	15%	10%	5%	5%	50%									
Course Description	The Fab Lab is intended to promote ‘Do It Yourself’ (DIY) concept through various manufacturing/ prototyping methods to provide a comprehensive idea to the students about the product development and fabrication.													
Course Objective	The course should enable the students to 1. Introduce the concepts of innovation in engineering design 2. Introduce tools, equipment and methods of various fabrication techniques 3. Familiarize the 3D Printing 4. Hands on experience in design and fabrication													
Course Outcome	Upon completion of this course, the students will be able to 1. Create different types of joints using welding and soldering process 2. Handle power tools for wood and metal fabrication process 3. Do 3D printing of simple objects 4. Use the Laser Cutting machine to fabricate the required shapes 5. Develop simple automation in pneumatics													
Prerequisites: NIL														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	1	2	1	-	-	-	-	-	-	1	2	2
CO-2	2	1	2	1	2	-	-	-	-	-	-	2	1	1
CO-3	1	1	2	2	1	-	-	-	-	-	-	1	2	2
CO-4	1	2	1	1	1	-	-	-	-	-	-	2	1	1
CO-5	2	1	2	2	2	-	-	-	-	-	-	1	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
LIST OF EXPERIMENTS with expected Learning outcome														
Exp. No.	Experiment Name													CO / BTL
1	Welding: Create a BUTT Joint using Welding Process. Software/Equipment Required: Arc/MIG/TIG Welding Equipment Setup													CO 1 & BTL 3
2	Welding: Create a LAP Joint using Welding Process. Software/Equipment Required: Arc/MIG/TIG Welding Equipment Setup													CO 1 & BTL 3
3	Welding: Create a T Joint using Welding Process. Software/Equipment Required: Arc/MIG/TIG Welding Equipment Setup													CO 1 & BTL 3

4	Soldering: Prepare a simple voltage regulator circuit in general purpose PCB using soldering process Software/Equipment Required: Solder and basic electronic Components	CO 1 & BTL 3
5	Power Tools: Study of Power Tools available for fabrication process. Software/Equipment Required: Power tools for Mechanical operations like wood cutting tools, metal cutting tools, grinding machine, drilling machine and polishing machine– jig saw, hand held machine saw, angle grinder, drilling machine and polishing machine.	CO 2 & BTL 3
6	Power Tools: Make a wooden panel/wood frame using wood cutting tools Software/Equipment Required: Wood Cutting Tools	CO 2 & BTL 3
7	Power Tools: Make a Metal fabrications using power tools like grinding etc., Software/Equipment Required: Grinding Machine	CO 2 & BTL 3
8	Drilling: Make the design in metal plates using drilling process Software/Equipment Required: Drilling Machine with accessories	CO 2 & BTL 3
9	3D Printer: Generate a simple 3D model in CAD and 3D print the part. Software/Equipment Required: 3D Printer	CO 3 & BTL 3
10	Laser Cutting: Make a unique design and fabricate in acrylic sheets using laser cutting Process. Software/Equipment Required: Laser Cutting Machine	CO 4 & BTL 3
11	Pneumatics: Assemble the pneumatic components to activate a single acting cylinder. Software/Equipment Required: SMC Pneumatic Kit	CO 5 & BTL 3
12	Pneumatics: Assemble the pneumatic components to activate a Double acting cylinder. Software/Equipment Required: SMC Pneumatic Kit	CO 5 & BTL 3
TEXT BOOKS		
1	Julia Walter-Herrmann, Corinne Büching, (2017). Fab Lab: Of Machines, Makers and Inventors, Transcript Verlag.	

COURSE TITLE	OUTREACH (NCC)-LEVEL 1 (ARMY WING)			CREDITS	1
COURSE CODE	GGE51401	COURSE CATEGORY	HS	L-T-P-S	0-0-2-4
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	Practical
15%	15%	10%	5%	5%	50%
Course Description	The NCC provides exposure to the cadets in a wide range of activities., with a distinct emphasis on Social Services, Discipline and Adventure Training.				

Course Objective	The training curriculum of the NCC is primarily focused on character building, inculcating leadership qualities and skill enhancement through structured academic syllabi, practical training and opportunity for exposure/interaction beyond a cadets’ immediate environment, and thereby enabling them for a brighter and progressive future.													
Course Outcome	1. To develop character, comradeship, discipline, secular outlook, spirit of adventure and the ideals of selfless service amongst the youth of the country. 2. To create a human resource of organized, trained and motivated youth to provide leadership in all walks of life and always available for the service of the nation. 3. To provide a suitable environment to motivate the youth to take up a career in the Armed Forces.													
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	1	1	-	2	1	3	2	3	3	2	-	-
CO-2	1	2	1	1	-	2	1	3	2	3	3	2	-	-
CO-3	1	2	1	1	-	2	1	3	2	3	3	2	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: NCC GENERAL (6P)														
NCC GENERAL: NCC 1 Aims, Objectives & Organization of NCC 1 NCC 2 Incentives 2 NCC 3 Duties of NCC Cadet 1 NCC 4 NCC Camps: Types & Conduct 2												CO-1 BTL-3		
MODULE 2: NATIONAL INTEGRATION AND AWARENESS (6P)														
NATIONAL INTEGRATION AND AWARENESS 4 NI 1 National Integration: Importance & Necessity 1 NI 2 Factors Affecting National Integration 1 NI 3 Unity in Diversity & Role of NCC in Nation Building 1 NI 4 Threats to National Security 1												CO-2 BTL-3		
MODULE 3: PERSONALITY DEVELOPMENT. (6P)														
PERSONALITY DEVELOPMENT 7 PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving 2 PD 2 Communication Skills 3 PD 3 Group Discussion: Stress & Emotions 2												CO-3 BTL-3		
MODULE 4: LEADERSHIP (6P)														
LEADERSHIP 5 L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour ‘ Code 3 L 2 Case Studies: Shivaji, Jhansi Ki Rani 2												CO-4 BTL-3		
MODULE 5: SOCIAL SERVICE AND COMMUNITY DEVELOPMENT (6P)														

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT 8 SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth 3 SS 4 Protection of Children and Women Safety 1 SS 5 Road / Rail Travel Safety 1 SS 6 New Initiatives 2 SS 7 Cyber and Mobile Security Awareness 1		CO-5 BTL-3
TEXT BOOKS		
1.	<u>NCC COMMON SUBJECT BOOK</u>	
2.	<u>RED BOOK (ARMY SPECIAL SUBJECTS)</u>	

COURSE TITLE	OUTREACH (NCC)- LEVEL 1 (AIR WING)			CREDITS	1
COURSE CODE	GGE51401	COURSE CATEGORY	HS	L-T-P-S	0-0-2-4
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	Practical
15%	15%	10%	5%	5%	50%
Course Description	The NCC provides exposure to the cadets in a wide range of activities., with a distinct emphasis on Social Services, Discipline and Adventure Training.				
Course Objective	The training curriculum of the NCC is primarily focused on character building, inculcating leadership qualities and skill enhancement through structured academic syllabi, practical training and opportunity for exposure/interaction beyond a cadets' immediate environment, and thereby enabling them for a brighter and progressive future.				
Course Outcome	1. To develop character, comradeship, discipline, secular outlook, spirit of adventure and the ideals of selfless service amongst the youth of the country. 2. To create a human resource of organized, trained and motivated youth to provide leadership in all walks of life and always available for the service of the nation. 3. To provide a suitable environment to motivate the youth to take up a career in the Armed Forces.				

CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	1	1	-	2	1	3	2	3	3	2	-	-
CO-2	1	2	1	1	-	2	1	3	2	3	3	2	-	-
CO-3	1	2	1	1	-	2	1	3	2	3	3	2	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: NCC GENERAL (6P)														
NCC GENERAL: NCC 1 Aims, Objectives & Organization of NCC 1 NCC 2 Incentives 2 NCC 3 Duties of NCC Cadet 1 NCC 4 NCC Camps: Types & Conduct 2												CO-1 BTL-3		
MODULE 2: NATIONAL INTEGRATION AND AWARENESS (6P)														
NATIONAL INTEGRATION AND AWARENESS 4 NI 1 National Integration: Importance & Necessity 1 NI 2 Factors Affecting National Integration 1 NI 3 Unity in Diversity & Role of NCC in Nation Building 1 NI 4 Threats to National Security 1												CO-2 BTL-3		
MODULE 3: PERSONALITY DEVELOPMENT. (6P)														
PERSONALITY DEVELOPMENT 7 PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving 2 PD 2 Communication Skills 3 PD 3 Group Discussion: Stress & Emotions 2												CO-3 BTL-3		
MODULE 4: LEADERSHIP (6P)														
LEADERSHIP 5 L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour ' Code 3 L 2 Case Studies: Shivaji, Jhansi Ki Rani 2												CO-4 BTL-3		
MODULE 5: SOCIAL SERVICE AND COMMUNITY DEVELOPMENT (6P)														
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT 8 SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth 3 SS 4 Protection of Children and Women Safety 1 SS 5 Road / Rail Travel Safety 1 SS 6 New Initiatives 2 SS 7 Cyber and Mobile Security Awareness 1												CO-5 BTL-3		
TEXT BOOKS														
1.	NCC COMMON SUBJECT BOOK													
2.	RED BOOK (ARMY SPECIAL SUBJECTS)													

COURSE TITLE	OUTREACH (NCC)- LEVEL 1 (NAVY WING)				CREDITS	1									
COURSE CODE	GGE51401	COURSE CATEGORY	HS	L-T-P-S	0-0-2-4										
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
CIA					ESE										
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Practical										
15%	15%	10%	5%	5%	50%										
Course Description	The NCC provides exposure to the cadets in a wide range of activities., with a distinct emphasis on Social Services, Discipline and Adventure Training.														
Course Objective	The training curriculum of the NCC is primarily focused on character building, inculcating leadership qualities and skill enhancement through structured academic syllabi, practical training and opportunity for exposure/interaction beyond a cadets’ immediate environment, and thereby enabling them for a brighter and progressive future.														
Course Outcome	1. To develop character, comradeship, discipline, secular outlook, spirit of adventure and the ideals of selfless service amongst the youth of the country. 2. To create a human resource of organized, trained and motivated youth to provide leadership in all walks of life and always available for the service of the nation. 3. To provide a suitable environment to motivate the youth to take up a career in the Armed Forces.														
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO -2	
CO-1	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-2	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-3	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: NCC GENERAL							(6P)								
NCC GENERAL: NCC 1 Aims, Objectives & Organization of NCC 1 NCC 2 Incentives 2 NCC 3 Duties of NCC Cadet 1 NCC 4 NCC Camps: Types & Conduct 2												CO-1 BTL-3			
MODULE 2: NATIONAL INTEGRATION AND AWARENESS															(6P)

NATIONAL INTEGRATION AND AWARENESS 4 NI 1 National Integration: Importance & Necessity 1 NI 2 Factors Affecting National Integration 1 NI 3 Unity in Diversity & Role of NCC in Nation Building 1 NI 4 Threats to National Security 1		CO-2 BTL-3
MODULE 3: PERSONALITY DEVELOPMENT.		(6P)
PERSONALITY DEVELOPMENT 7 PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving 2 PD 2 Communication Skills 3 PD 3 Group Discussion: Stress & Emotions 2		CO-3 BTL-3
MODULE 4: LEADERSHIP		(6P)
LEADERSHIP 5 L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour ' Code 3 L 2 Case Studies: Shivaji, Jhasi Ki Rani 2		CO-4 BTL-3
MODULE 5: SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		(6P)
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT 8 SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth 3 SS 4 Protection of Children and Women Safety 1 SS 5 Road / Rail Travel Safety 1 SS 6 New Initiatives 2 SS 7 Cyber and Mobile Security Awareness 1		CO-5 BTL-3
<u>TEXT BOOKS</u>		
<u>1.</u>	<u>NCC COMMON SUBJECT BOOK</u>	
<u>2.</u>	<u>RED BOOK (ARMY SPECIAL SUBJECTS)</u>	

COURSE TITLE	OUTREACH (NSS, Y's Men, Rotract)- LEVEL I			CREDITS	1
COURSE CODE	GGE51402	COURSE CATEGORY	HS	L-T-P-S	0-0-2-4
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	-
ASSESSMENT SCHEME					
CIA					ESE
Volunteering	Events attended	Awareness Programs attended	Attendance	Report Submission	

5%	25%	15%	5%	50%										
Course Description	This course is designed to introduce students to the principles and practices of community service, social development, and active citizenship. The course aims to instill a sense of social responsibility and promote civic engagement among the participants. Through a combination of theoretical knowledge and practical experiences, students will develop essential skills and qualities required to make a positive impact on the community and society. Pre requisite: There are no specific prerequisites for enrolling in the NSS Semester 1 course. However, a genuine interest in community service, social development, and willingness to actively engage with diverse communities are essential.													
Course Objective	1. To familiarize students with the objectives, history, and importance of the National Service Scheme (NSS) in community development, emphasizing the significance of social responsibility and civic engagement. 2. To develop essential leadership skills, teamwork, and effective project management techniques, preparing students to organize and execute community service projects successfully. 3. To cultivate empathy, compassion, and cultural sensitivity, enabling students to engage respectfully and effectively with diverse communities during their community service activities. 4. To promote environmental awareness and sustainable practices, encouraging students to integrate eco-friendly approaches into their community service initiatives. 5. To enhance students' communication, problem-solving, and decision-making skills, equipping them to engage with community members, stakeholders, and address challenges effectively.													
Course Outcome	1. students will gain a comprehensive understanding of the objectives, history, and significance of the National Service Scheme (NSS) in promoting community development and social responsibility. 2. Participants will demonstrate the ability to identify and assess prevalent social issues and challenges in the community, laying the groundwork for effective community service initiatives. 3. Through practical experiences and workshops, students will develop essential leadership skills, teamwork, and project management techniques necessary for organizing and executing successful community service projects. 4. By engaging with diverse communities, students will cultivate empathy, compassion, and cultural sensitivity, fostering meaningful and respectful interactions during their service activities. 5. Upon completion of Semester 1, students will have improved their communication, problem-solving, and decision-making skills, empowering them to actively and effectively engage in community development and service projects.													
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	1	1	-	2	1	3	2	3	3	2	-	-

CO-2	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-3	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-4	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-5	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
1: Weakly related, 2: Moderately related and 3: Strongly related															
TOPICS TO BE COVERED															
1. Introduction to National Service Scheme (NSS) and its Objectives 2. Understanding Social Issues and Needs Assessment in the Community 3. Project Planning and Management for Community Service 4. Leadership Development and Teamwork 5. Cultural Sensitivity and Interacting with Diverse Communities 6. Communication and Problem-Solving Skills for Community Engagement 7. Environmental Conservation and Sustainable Practices 8. Health, Hygiene, and Community Well-being 9. The Role of Arts and Culture in Community Development 10. Reflecting on Community Service Experiences and Personal Growth															
Suggest Activities 1. Community Cleanliness Drive: Organize a cleanliness drive in the local community, involving students and residents in cleaning public spaces and creating awareness about cleanliness and waste management. 2. Health Awareness Camp: Conduct a health awareness camp where participants can provide basic health check-ups, distribute health-related information, and promote the importance of hygiene and sanitation. 3. Environmental Conservation Project: Initiate an environmental conservation project, such as tree planting, creating green spaces, or implementing recycling programs, to raise awareness about environmental issues. 4. Teaching Assistance in Local Schools: Collaborate with local schools to provide teaching assistance, conduct educational workshops, and help students with their studies. 5. Empowerment Workshops: Organize workshops for women, youth, or other marginalized groups to empower them with skills and knowledge relevant to their needs, such as vocational training or financial literacy. 6. Cultural Exchange Program: Arrange a cultural exchange event where NSS participants and local community members can share their traditions, dances, music, and food, fostering mutual understanding and appreciation. 7. Blood Donation Camp: Partner with local healthcare institutions to organize a blood donation camp to address blood shortages and raise awareness about the importance of donating blood. 8. Community Survey and Needs Assessment: Conduct a comprehensive community survey to understand the needs and priorities of the local residents, guiding the selection of future service projects. 9. Awareness Campaigns: Create awareness campaigns on critical social issues like gender equality, education, or substance abuse through street plays, posters, and interactive sessions. 10. Disaster Preparedness Workshop: Conduct workshops on disaster preparedness, including first aid training and emergency response, to equip the community with necessary skills. 11. Senior Citizens' Engagement: Plan activities and events to engage and support senior citizens, such as organizing social gatherings or providing assistance with daily chores.															(30P)

12. Digital Literacy Initiatives: Set up digital literacy workshops to help community members, especially elders and underserved individuals, to learn basic computer and internet skills.	
13. Community Sports Event: Organize a community sports event to promote fitness, teamwork, and community bonding.	
14. Skill Development Sessions: Arrange skill development workshops in collaboration with local experts to teach practical skills like tailoring, painting, or handicrafts.	
15. Awareness on Government Schemes: Educate the community about various government schemes and programs that they may be eligible for, to ensure they can avail themselves of the benefits.	
REFERENCE BOOKS	
1	National Service Scheme Manual, Government of India.
2	Orientation Courses for N.S.S. Programme officers, TISS.
3	Case material as Training Aid for field workers, Gurmeet Hans.
4	National Service Scheme Manual, Government of India.
5	Training Programme on National Programme scheme, TISS.
6	Social Problems in India, Ram Ahuja
7	Social service opportunities in Hospitals, Kapil K. Krishan, TISS.

COURSE TITLE		TAMIL			CREDITS	2
COURSE CODE		GLS51008	COURSE CATEGORY	HS	L - T - P - S	2 - 0 - 0 - 2
Version	1.0	Approval Details		36 th ACM	LEARNING LEVEL	BTL- 3
ASSESSMENT SCHEME						
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”		Attendance	End Semester Examination ESE
15%	15%	10%	5%		5%	50%
Course Description	This Tamil course improves Tamil language skills of the students’ Tamil letters and Grammar are included. This course provides an opportunity not only to get interest in learning Tamil Language but also, they can learn to converse easily.					
Course Objective	1. By studying this course, students will be able to write and speak Tamil easily in any situation, daily life and daily conversations. 2. Develops language and interest in learning in students. 3. Facilitates students to create opportunities for themselves in the society. 4. Students also learn Tamil literature by developing interest in language department. 5. This lesson plan helps the students to learn about the culture by learning the Tamil language.					
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the Letters and basic words of Tamil Language which are in daily use 2. Develops the listening skills of Tamil language					

3. Utilize the letters and common words of the language for communication 4. Develop the conversational skills 5. Demonstrate the skill of reading and writing														
Prerequisites: Plus Two -Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	-	-	2	2	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	2	-	-	3	2	-	-	-
CO5	-	-	-	-	-	-	-	-	2	3	2	3	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
அலகு - 1 தமிழ் எழுத்துக்கள்													(6 L)	
தமிழ் எழுத்துகள் - ஒசைகள் - எண்கள் - வண்ணங்கள் - வடிவங்கள் - ஓர் எழுத்துச் சொற்கள் - பழங்கள் மற்றும் காய்கறிகள் - மலர்கள் - இயற்கை - மாதங்கள் சொற்கள் - பெயர்சொற்கள் - உரிச்சொற்கள் - வினைச்சொற்கள் - காலங்கள் - வாழ்த்துகள். வகுப்பறை செயல்முறைகள் : 1. வார்த்தைகளை வட்டமிடுதல். 2. விடுபட்ட எழுத்துகளை நிரப்புக. 3. வடிவங்களுக்கு வண்ணம் தீட்டுக.													CO-1 BTL-2	
அலகு - 2 கேட்டல் மற்றும் உச்சரித்தல்													(6L)	
உயிரெழுத்துகள், மெய்யெழுத்துகள் மற்றும் உயிர்மெய் எழுத்துகளை உச்சரித்தல் - சிறுகதைகள் வாசித்தல் - எதிர்ச்சொற்கள் - பொருள்தருக - வாக்கியத்தில் அமைத்து எழுதுதல் - ஒரு சொல்லில் விடையளித்தல். வகுப்பறை செயல்முறைகள் : 1. சொற்களைக் கேட்டு உச்சரிக்க செய்தல். 2. குழுவிலாவதம் செய்தல். 3. கோடிட்ட இடங்களைச் சரியான சொற்களைக் கூறுதல்.													CO-2 BTL-2	
அலகு -3 எழுத்துப் பயிற்சி													(6 L)	
தமிழ் எழுத்துகளை எழுத கற்பித்தல் - உயிர் எழுத்துகள் - மெய் எழுத்துகள் - உயிர்மெய் எழுத்துகள் - ஆயுத எழுத்து - சார்பெழுத்துகள் - ஒற்றெழுத்துகள் - ஒரு சொல் - இருசொல் எழுதுதல் - ஒருவரி, இருவரி எழுதுதல். வகுப்பறை செயல்முறைகள்: 1. கோடிட்ட இடங்களை நிரப்புக. 2. சரியான எழுத்துகளை வட்டமிடுதல். 3. ஒருவரி சொற்களை எழுதுதல்.													CO-3 BTL-3	
அலகு - 4 உரையாடல்கள் கற்பித்தல்													(6L)	
சிறு உரையாடல்கள் கற்பித்தல் - வாழ்த்துக்கள் - வங்கியில் பணம் செலுத்துதல் - சந்தையில் கடைகாரரிடம் உரையாடுதல், பொது இடங்களில் உரையாடுதல். வகுப்பறை செயல்முறைகள்: 1. குறு நாடகங்கள் நடித்து உரையாடல்கள் கற்பித்தல்.													CO-4 BTL-2	

2. விண்ணப்ப படிவங்கள் பூர்த்தி செய்தல். 3. மின்னல் அட்டைகள் காண்பித்தல்.		
அலகு - 5 தமிழ் வாசிக்க மற்றும் எழுத கற்பித்தல்		(6 L)
கடிதங்கள் வாசித்தல் மற்றும் எழுதுதல் - விண்ணப்ப கடிதம், வங்கிகணக்கு படிவங்கள், இரயில் முன்பதிவு விண்ணப்ப படிவம் பூர்த்திசெய்தல் - கவிதை வாசித்தல் - செய்திதாள் வாசித்தல். வகுப்பறை செயல் முறைகள்: 1. விண்ணப்ப படிவங்கள் பூர்த்திசெய்தல். 2. கவிதை வாசித்தல் போட்டிகள் 3. வகுப்பறை தேர்வுகள்		CO-5 BTL-3
TEXT BOOK		
1.	Saidhai. P. Sundaramurthy (2018). Learn Tamil Through english. Manimekalai Prasuram. Chennai - 17. Pages 1 to 84	
2.	Pulavar Kulanthai (2020). Students Basic Tamil. Manimekalai Prasuram. Chennai -17. Pages1 to 84	
REFERENCE BOOKS		
1.	Lena tamil vanan. (2017). Easy Tamil Grammar. Manimekalai Prasuram, Chennai -17, Pages 11 to 21	
2.	Tamilnadu Board - NCERT/CBSE-Books Class – 6 th TO 9 th (2021-2022)	
E-REFERENCES		
1	https://cbsetamil.com/cbse-tamil-book/ , https://tamil.examsdaily.in/tnpsc-tamil-ilakkanam-material-pdf-download	

COURSE TITLE		HINDI		CREDITS	2
COURSE CODE	GLS51009	COURSE CATEGORY	HS	L - T - P - S	2 - 0 - 0 - 2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	BTL LEVEL	3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC" etc.,	Attendance	End Semester Examination ESE
15%	15%	10%	5%	5%	50%
Course Description	This course has been designed to develop the regional language skills of the students. The course includes Hindi language, literature, vocabulary and grammar. This course teaches students how to communicate accurately, appropriately and fluently in regional language.				
Course Objective	1. To provide an environment to Speak and write in Hindi at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate. 2. To equip the students to Read, comprehend and answer questions based on literary texts. 3. To help student to become sensitive to the requirements of the society and respond to it in a constructive way. 4. To provide an environment to students to read and appreciate the literature.				

Course Outcome	Upon completion of this course, the students will be able to														
	1. Demonstrate the ability to write the grammatically correct sentences with accuracy.														
	2. Integrating various components of Hindi Language and determining it through reading and listening.														
	3. Organize and articulate ideas, concepts, and perceptions in a comprehensive manner in written correspondence, and speaking in formal and informal situations.														
	4. Infer details from after listening and reading and implement it in various professional situations.														
5. Develop writing and speaking skills.															
Prerequisites: Plus Two -Intermediate Level															
CO, PO AND PSO MAPPING															
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO- 9	PO 10	PO 11	PO 12	PS O1	PS O2	
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	
CO2	-	-	-	-	-	-	-	2	2	3	-	-	-	-	
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	
CO4	-	-	-	-	-	-	2	-	-	3	2	-	-	-	
CO5	-	-	-	-	-	-	-	-	2	2	-	2	-	-	
1: Weakly related, 2: Moderately related and 3: Strongly related															
मॉड्यूल 1: हिंदी पत्र और लिपि (6L)															
हिंदी स्वर और व्यंजन अक्षर - आश्रित स्वर सीखें - व्यंजन और व्यंजन समूह - अनुस्वर व्यंजन - संज्ञा - सर्वनाम - क्रिया (भविष्य) - संभावित विशेषण - काल - हिंदी के त्वरित नियम - अभिवादन - 2 अक्षर शब्द बनाना, 3 अक्षर शब्द - हर दिन शब्दावली - संख्याएं - रंग - परिवार - वस्त्र - बगीचा - घर - फल और सब्जियां - प्रकृति													CO-1		
सुझाई गई गतिविधियां:													BTL-2		
देशी वक्ताओं द्वारा स्वर और व्यंजन का उच्चारण सुनना															
स्वर और व्यंजन के वीडियो, 2 अक्षर और 3 अक्षर के शब्द, और प्रतिदिन प्रयोगार्थ शब्दावली															
मॉड्यूल 2: सुनने का कौशल (6 L)															
स्वर और व्यंजन का उच्चारण सुनना - लघु कथाएँ सुनना - साक्षात्कार - भाषण - सामाजिक मुद्दों पर पॉड वार्ता - निर्धारित पाठों को सुनना: इकाई 1 सभ्यता का रहस्य, इकाई 2 - युवाओं से - वार्तालापों को सुनना - जानकारी सुनना - सम्मेलनों के भाषण													CO-2		
सुझाई गई गतिविधियां:													BTL-3		
सुनें और चुनें															
उम्मीदवार पाठ को सुनते हैं और तीन विकल्पों के साथ बहुविकल्पीय प्रश्न का उत्तर देते हैं।															
उम्मीदवार टीवी चैनलों में बातचीत - साक्षात्कार- अतिथि व्याख्यान, सम्मेलनों और कार्यशालाओं के दौरान विशेषज्ञों के भाषण सुनते हैं															

मॉड्यूल 3: बोलने का कौशल		(6 L)
औपचारिक संवाद - अनौपचारिक संवाद - लिंग रूपों के साथ बोलना - संख्या - काल - परिवार, शहर, त्योहारों, शौक आदि जैसे सामान्य विषयों पर बोलना - पसंद और नापसंद व्यक्त करना - ज़रूरतें और संपत्ति - भूमिका निभाना। सुझाई गई गतिविधियां: प्रस्तुति – कार्यक्रमों का संचालन - भाषण देना		CO-3 BTL-3
मॉड्यूल- 4 : पढ़ने का कौशल		(6 L)
नमूना पढ़ना - नकल पढ़ना - अक्षरों और शब्दों का सही उच्चारण करना - पढ़ने में प्रवाह - कहानियाँ पढ़ना- संपादकीय, समाचारपत्र के लेख पढ़ना। सुझाई गई गतिविधियां फ्लैशकार्ड का उपयोग - चार्ट - चित्रों की पहचान करना - शब्दों को पढ़ना		CO-4 BTL-3
मॉड्यूल-5 लेखन कौशल		(6 L)
सामान्य पत्राचार - पत्र लेखन: छुट्टी लेने पत्र, बैंक खाता खोलना, पुस्तकें मंगवाने के लिए पत्र, शिकायत पत्र - संकेत विकास - ज्ञापन - नोटिस सुझाई गई गतिविधियां: निर्धारित पाठ्यपुस्तक के अनुसार अभ्यास पूरा करना		CO-5 BTL-3
पाठ्य पुस्तक		
1.	Sashtri. S.R.(2019). Hindi Shikshak, Dakshina Bharat Hindi Prachar Sabha, Chennai (Pages 137)	
संदर्भ पुस्तकें		
1.	Prathamatic Patya Pushthak. (2022), Dakshina Bharath Hindi Prachar Sabha, Chennai. (Pages 168)	
2.	Madhyama Patya Pushthak. (2022) Dakshina Bharath Hindi prachar Sabha, Chennai (Pages 184)	
ई-संदर्भ		
1.	https://www.hindipod101.com/	

COURSE TITLE		TELUGU		CREDITS		2
COURSE CODE		GLS51010	COURSE CATEGORY	HS	L - T - P - S	2 - 0 - 0 - 2
Version	1.0	Approval Details	36 th ACM	BTL LEVEL		3
ASSESSMENT SCHEME						

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments / Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”etc.,				Attendance	ESE						
15%	15%	10%	5%				5%	50%						
Course Description		This course has been designed to meet students' current and future language and communication needs. It attempts to develop their proficiency in the four language skills and knowledge of grammar and vocabulary. This course teaches students how to communicate accurately, appropriately and fluently in professional and social situations.												
Course Objectives		1.This course is aimed to teach the basic Telugu language speaking skills. 2.It will introduce basic skills of the Telugu Language: its alphabets, essential words and simple sentence construction methods. 3.The course intends to facilitate students in acquiring foundational skills of reading, writing and speaking Telugu along with synonyms to expand vocabulary.												
Course Outcome		Upon completion of this course, the students will be able to 1.Demonstrate the basic skills of Letters and sounds in Telugu. 2.Develop the basic vocabulary for every day’s conversation. 3.Construct simple Telugu sentences with the simple words. 4.Utilize the words that have conjunct character, and can learn functional, everyday conversation. 5.Construct Simple sentences for delivering appropriate meaning.												
Prerequisites: Plus Two Telugu-Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	-	-	2	2	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	2	-	-	3	2	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	2	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
భాగము 1 : వినడం, చెప్పడం మరియు రాయడం									(6L)					
తెలుగు అచ్చులు & హల్లులు శబ్దాలు ధ్వనిచిత్రంతో పాటు తెలుగు హల్లుల సంయోగాల పరిచయం సూచించబడిన : కార్య కలాపాలు చర్చలు : 5 గంటలు . అసైన్మెంట్లు / ప్రెజెంటేషన్ - 5 గంటలు												CO-1		
												BTL-2		
భాగము 2 : పేర్ల పదాలకు, సంఖ్యలకు, మరియు వాటి గుణాల పరిచయం									(6L)					
తెలుగు నామవాచకం పరిచయం తెలుగు సర్వనామం & దాని విషయం సంఖ్యలు దాని పరిచయం & తెలుగు విశేషణాలు పరిచయం సూచించబడిన : కార్య కలాపాలు చర్చలు : 5 గంటలు . అసైన్మెంట్లు / ప్రెజెంటేషన్ - 5 గంటలు												CO-2 BTL-3		
భాగము 3 : పదాలను విడదీసి వాక్యాలను రాయడం									(6L)					
తెలుగు పూర్వ పదాలు – సంయోగాలు మరియు దాని ఉపయోగం												CO-3 BTL-3		

సూచించబడిన : కార్య కలాపాలు		
చర్చలు : 5 గంటలు . అసైన్మెంట్లు /ప్రెజెంటేషన్ - 5 గంటలు		
భాగము 4 : పనులు, సమయం, క్రియ మరియు కాల వ్యవధుల పరిచయం		(6L)
వివిధ క్రియల యొక్క క్రియ & సమయం / కాల సంయోగానికి పరిచయం		
సూచించబడిన : కార్య కలాపాలు		CO-4
చర్చలు : 5 గంటలు . అసైన్మెంట్లు /ప్రెజెంటేషన్ - 5 గంటలు		BTL-3
భాగము 5 : తెలుగు చదవడం, రాయడం మరియు ప్రశ్నించడం		(6L)
తెలుగులో సరళమైన వాక్యాలను రూపొందించడం (ప్రాథమిక వాక్య నిర్మాణ నియామాలు)		
తెలుగులో ప్రతీకూల వాక్యాలును రూపొందించడం		
తెలుగు బోధన అభ్యాస ప్రక్రియలో ప్రశ్నార్థకవాక్యాలువాక్యాలను రూపొందించడం		
సూచించబడిన : కార్య కలాపాలు		CO-5
చర్చలు : 5 గంటలు . అసైన్మెంట్లు /ప్రెజెంటేషన్ - 5 గంటలు		BTL-3
TEXT BOOK		
1.	Telugu Akademy. (2018). Sampradaya Telugu Vyakaranalu. Telugu Akademy. Vijayawada, Andhra Pradesh. India.	
2.	Raghavendra. A. (2019). Telugu Vyakaranam. Prajasakti Book House. Tadepalli.	
REFERENCE BOOKS		
1.	Ramaraao, Chekuri. (2019). A Reference Grammar of Modern Telugu. Emesco Books. Hyderabad	
2.	Vemuri, V. Rao. (2020). Learn Telugu with Its Grammar, Eco Foundation, Vijayawada.	
E-References		
1	https://sarkarihelp.com/telugu-grammar-pdf-download/	

COURSE TITLE		FRENCH			CREDITS	2
COURSE CODE		GLS51011	COURSE CATEGORY	HS	L - T - P - S	2 - 0 - 0 - 2
Version	1.0	Approval Details	36 th ACM		LEARNING LEVEL	BTL – 3
ASSESSMENT SCHEME						
CIA						End Semester Examination (ESE) Theory
First Periodical Assessment	Second Periodical Assessment	Weekly assignment/ lab record and viva as approved by the Department Examination Committee “DEC”	Surprise Test / Quiz., as approved by the Department Examination Committee “DEC”	Attendance		
15 %	15 %	10 %	5 %	5 %		
Course Description					Introduces students to the culture and language of the French-speaking world. Students develop an ability to communicate in real-life situations by acquiring reading, writing, listening, and speaking skills. The elementary courses prepare students to communicate successfully in some common basic social situations using the four language skills—listening, speaking, reading, and writing—within appropriate cultural contexts. The student will also acquire an understanding of cross-cultural awareness.	

Course Objective	1. To discover basic elements of the language, such as the different phonemes, the alphabet and its pronunciation 2. To discover the foundation of the language such as conjugations, auxiliaries, numbers, etc. 3. To learn how to form simple sentences about personal topics such as one's family 4.To start interacting with others by asking and answering simple questions 5. Understand your learning style and be able to check your own progress.													
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate advanced proficiency in spoken and written French. 2. Demonstrate the ability to read critically, interpret analytically, speak persuasively, and write coherently about visual and literary texts produced in the French-speaking world. 3. Demonstrate familiarity with methodological approaches in the study of literary and cultural texts, such as close reading, socio-historical contextualization, and literary and cultural theory. 4. Demonstrate knowledge of literary and cultural traditions, such as major movements, writers, and works of the French-speaking world, focusing on at least one and ideally multiple traditions: European, African, Caribbean, Asian, North American, and other Francophone cultures. 5. Demonstrate the skills necessary for scholarly research and writing in the Humanities.													
Prerequisites: Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	-	-	-	-	-	-	-	-	-	3	-	-		
CO2	-	-	-	-	-	-	-	2	2	3	-	-		
CO3	-	-	-	-	-	-	-	-	-	3	-	-		
CO4	-	-	-	-	-	-	2	-	-	3	2	-		
CO5	-	-	-	-	-	-	-	-	2	3	2	3		
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE – 1: INTRODUCTION FRANÇAISE														(6L)
.1 Introduction au cours de français - 1hr 1.2 La France et ses clichés - 2hr 1.3 Première rencontre (saluer, prendre congé, parler de son humeur) - 1hr 1.4 Qui es-tu? (se présenter, les chiffres 1-20, <i>être</i> et <i>avoir</i>) - 2hrs 1.5 Activité fiche d'identité													CO-1 BTL-2	
MODULE – 2: LE MONDE QUI M'ENTOURE														(6L)
2.1 Quel temps fait-il? (la météo, les chiffres 20-49) - 1hr 2.2 Mes couleurs préférées (la possession, le genre des articles) - 2hrs 2.3 Introduction à la Révolution Française - 2hrs 2.4 Me repérer dans le temps 1: la date (mois, jours, années) - 2hr 2.5 Me repérer dans le temps 2: l'heure (chiffres 49-60) - 2hrs													CO-2 BTL-3	
MODULE – 3: MES GOÛTS														(6L)
3.1 La nourriture en France - 2hrs 3.2 Exprimer ses goûts (verbes du 1er groupe, négation verbale) - 2hrs 3.3 Manger et boire en France - 1hr													CO-3 BTL-3	

3.4 Ma famille extraordinaire - 2hrs		
3.5 Activité “qui est qui?” - 2hrs		
MODULE – 4: MON QUARTIER EST UN MONDE		(6L)
4.1 Mon quartier idéal (lieux de la ville, prépositions de lieu, <i>habiter</i> et <i>vivre</i>) - 2hrs		CO-4 BTL-3
4.2 C’est par où? (verbe <i>aller</i> , les directions, l’impératif, donner des indications) - 2hrs		
4.3 Activité “où vont-ils?” trouver l’itinéraire - 1hr		
4.4 On y va comment? (les transports, <i>conduire</i> et <i>prendre</i> , la préposition en/à) - 2hr		
4.5 Montmartre, un quartier pas comme les autres. 2hrs		
MODULE – 5: JOUR APRES JOUR		(6L)
5.1 Une journée ordinaire (verbes pronominaux, routine, emploi du temps) - 2hrs		CO-5 BTL-4
5.2 Mes petites habitudes (la fréquence définie et indéfinie) - 1hr		
5.3 Une carte postale de vacances - 2hrs		
5.4 La provenance et la destination (prépositions in, from, to, le genre des pays) - 1hr		
5.5 Mes vacances idéales (adjectifs démonstratifs) -2hr		
TEXT BOOKS		
1	1. <i>Ego 1 Cahier d’Activités</i> , Annie BERTHET & Co, Hachette 2006 2. <i>Version Originale Cahier d’Exercices</i> , Monique DENYER & Co, ED. Maison des Langues, 2011	
REFERENCE BOOKS		
1.	1. <i>Alter Ego 1</i>	
2.	2. <i>Version Originale 1</i>	
E Books		
1	1. www.lepointdufle.net 2. https://www.podcastfrancaisfacile.com/ 3. https://didierfle.com/ 4. https://lebaobabbleu.com/ 5. https://leszexpertsfle.com/ 6. https://www.ressourcesfle.fr/ 7. https://lecafedufle.fr/	

COURSE TITLE		GERMAN			CREDITS	2
COURSE CODE		GLS51012	COURSE CATEGORY	HS	L - T – P - S	2 – 0 – 0 - 2
Version	1	Approval Details	36 th ACM		LEARNING LEVEL	BTL – 3
ASSESSMENT SCHEME						
CIA						End Semester Examination (ESE) Theory
First Periodical Assessment	Second Periodical Assessment	Weekly assignment/ lab record and viva as approved by the Department Examination Committee “DEC”	Surprise Test / Quiz., as approved by the Department Examination Committee “DEC”	Attendance		
15 %	15 %	10 %	5 %	5 %		
50%						

Course Description	The students shall understand the basic German Language concepts and cultural difference. They can manage to understand and communicate in German when they travel to Germany.													
Course Objective	1) This course aims to equip the students with a basic daily communication in German. 2) The students learn the spoken German required to communicate with native speakers 3) It helps them to understand the 4 different modules (Hören, Schreiben, Sprechen and Lesen) which is required to clear the A1 first level international certificate exam. 4) The students learn the concepts which is required for pursuing their PG or Job in Germany													
Course Outcome	Upon completion of this course, the students will be able to 1. Recall and recognize the facts and use familiar, everyday expressions, create very simple sentences, which relate to the satisfying of concrete needs. 2. Understanding the texts and trying to communicate in a simple manner provided the person they are speaking to speaks slowly and clearly and is willing to help. 3. Understanding and recalling the basic German Vocabulary, Verb conjugations with pronouns, expressions and connecting the learned facts to communicate in simple German sentences 4. Applying the above learned facts and trying to create own sentences, E-mails etc. as per the basic level achieved 5. Understand the native speaker and apply the knowledge (at basic level) in writing and speaking parts.													
Prerequisites: Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO1 2	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	2	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 : SUPER!														(6L)
Jemanden vorstellen - Eine Hitliste internationaler Wörter schreiben - Nach dem Namen und der Herkunft fragen - Eine kursliste schreiben Grammatik: regelmäßige verben – möchten, sprechen,sein - Personalpronomen – ich,du,er,sie. - Definiter Artikel im nominative der, die, das - W -Ragen, Ja/Nein Fragen - Präpositionen - aus, in														CO-1 BTL-2
MODULE 2 : Menschen														(6L)
Jemanden nach dem Befinden fragen - Sich verabschieden - Interview: Informationen über die Familie erfragen und darüber berichten - Über seine Freunde und die Freunde anderer schreiben und sprechen Grammatik: Indefiniter Artikel – ein/eine - Negativartikel – kein/keine... Possessiveartikel - mein, dein, sein..														CO-2 BTL-3
MODULE 3 : Essen und Trinken														(6L)
Lebensmittel vergliechen - Lieblingfarbe und Lebensmittel zuordnen - Umfrage: mein Lieblingsfrühstück - Eine Einkaufsliste für ein Lieblingsessen schreiben Grammatik: Verb Konjugation – sein,haben - Imperative! Verbposition im Satz - W -Ragen, Ja/Nein Fragen														CO-3 BTL-3
MODULE 4 : Mein Leben														(6L)
Sich über Leben, Beruf, Herkunft, etc..austauschen - Eine Visitenkarte schreiben Interview: sich über den Tagensablauf austauschen - Die zahlen bis 100 Grammatik: Trennbaren verben_____ “man” und “negation nicht” benutzen____ Akkusativ(definite/indefinite/negative Artikel) - Präpositionen – um, als, für, bei														CO-4 BTL-3

MODULE 5 : Freizeit (6L)	
Ein kursposter mit Hobbys schreiben - Welche Hobbys habe ich,welche nicht - Notieren und sprechen – Was man selbst und die Familie am - Wochenende gerne macht- Über seinen Sonntag schreiben Grammatik: Modalverben - Präpositionen – in,am	CO-5 BTL-4
TEXT BOOKS	
1	Rolf Bruseke , Starten Wir! (A1) ,Hueber Verlag,2018
REFERENCE BOOKS	
1.	Stefanie Dengler, “Netzwerk neu A1.1 [Kurs und Übungsbuch]” ,Klett, 2015
2.	Harmut Aufderstrasse,Heiko Bock, “Themen 1 aktuell kursbuch”,Hueber,2003
E Books	
1.	https://www.learn-german-online.net/en/learning-german-resources/free-german-lessons-a1.htm

COURSE TITLE		Spanish								CREDITS		2		
COURSE CODE		GLS51013		COURSE CATEGORY				HS		L-T-P-S		2-0-0-2		
Version	1.0	Approval Details		36 th ACM				LEARNING LEVEL				BTL- 3		
ASSESSMENT SCHEME														
CIA											ESE			
First Periodical Assessment		Second Periodical Assessment		Seminar/ Assignments/ Project		Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”		Attendance						
15%		15%		10%		5%		5%		50%				
Course Description		This Spanish language course has been programmed to meet the grammatical and conversation needs of the student. Its content is very comprehensive and will also assist in the professional and personal language requirement of the student												
Course Objective		1. To facilitate the student in reaching out to international clients across the globe. 2. To make an immediate connect by speaking to the prospective client/ company in their native language. 3. To improve the overall personality of the student thereby making him/her more confident to communicate with global clients. 4. To provide survival skills to students relocating In countries where Spanish is spoken. This includes USA, all the Latin American countries and Spain.												
Course Outcome		1. Understand spoken Spanish and construction of basic sentences. 2. Creating conversations & oral understanding. 3. Enables the learners to decode a message and to give a suitable reply in the same manner. 4. Understanding the perceptions, phrases, and other vocabulary. 5. Understanding of not only the language but also culture, music, food and other aspects of the language.												
Prerequisites: Plus Two -Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	-	-	-	-	-	-	-	-	-	3	-	-		
CO2	-	-	-	-	-	-	-	2	2	3	-	-		
CO3	-	-	-	-	-	-	-	-	-	3	-	-		
CO4	-	-	-	-	-	-	2	-	-	3	2	-		
CO5	-	-	-	-	-	-	-	-	2	3	2	3		
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Introduction to Language & Communication (Part 1) (6L)														
1. El Alfabeto – The Alphabets 2. Numeros – Numbers 3. Saludos - Salutations 4. La hora – The Time Suggested Readings: USO (Basico) Dele Gramatica Epanola Author by Francisca Castro													CO-1 BTL-1	
MODULE 2: Introduction to Language & Communication (Part 2) (6L)														
1. Los Meses, La Semana- The Month, The week and the days of the year 2. Los Estaciones Delan’o – the Seasons of the year 3. En el Aeropuerto, Cpger El Taxi – At the Airport, Booking tickets 4. Hola – Salutations and Greetings 5. Durante La Clase – During the class 6. Art’culos – Different Articles Suggested Reading: USO (Basico) Dele Gramatica Epanola Author by Francisca Castro													CO-2 BTL-2	
MODULE 3: Understanding of Basic verb and Introduction to Grammar (6L)														
1. Verbp ser : Presente – Present tense of Verb “to be” 2. Estar / Hay – Conjugations of the verb “to be” and the verb there is / There are 3. Verbos En Presente: Regulares – Introduction to regular verbs 4. Ser / Estar / Tener – Conjugation of Irregular Verbs Suggested Reading: USO (Basico) Dele Gramatica Epanola Author by Francisca Castro													CO-3 BTL-3	
MODULE 4: Grammar and introduction to basic Concept (6L)														
1. Posesivos – Possessive Adjectives and Nouns 2. Colores – Colours and Expressions 3. La Familia – The Family and its members 4. Nombres Y Adjetivos – Nouns and Adjectives Literary Readings: USO (Basico) Dele Gramatica Epanola Author by Francisca Castro													CO-4 BTL-2	
MODULE 5 : (6L)														
1. Los nombres de la familia – Name of the Family Members 2. Relaciones – relations 3. Identificación de la tabla de familia - identification of the family table 4. Repaso del semestre entero - Full semester revision Literary Readings: USO (Basico) Dele Gramatica Epanola Author by Francisca Castro													CO-5 BTL-3	
TEXT BOOK														

1.	Módulo Mind your Language Institute
E-REFERENCES	
1	Open.umn.edu
2	Pdfdrive.com/francisa-castro

COURSE TITLE		Korean								CREDITS			2	
COURSE CODE		GLS51014		COURSE CATEGORY				HS		L-T-P-S			2-0-0-2	
Version	1.0	Approval Details		36 th ACM						LEARNING LEVEL			BTL- 3	
ASSESSMENT SCHEME														
CIA												ESE		
First Periodical Assessment		Second Periodical Assessment		Seminar/ Assignments/ Project		Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”				Attendance				
15%		15%		10%		5%				5%				50%
Course Description		Korean language will give you the opportunity to take a deep dive into Korean culture. The students will become more confident with their skills in communicating with their employers and potential customers. This course covers most basic grammatical structure and everyday vocabularies.												
Course Objective		1. To make the students get an upper hand in the prime industries of the world and direct access to the Korean speaking community. 2. To enable the students to create a direct connect thereby eliminating the requirement of a translator. 3. To improve the overall personality of the student thereby making them more confident to communicate with global clients. 4. To provide survival skills to students relocating to countries where Korean is spoken.												
Course Outcome		1. Develop the spoken Korean and construction of advanced sentences. 2. Enhance conversations & oral understanding of few communication concepts. 3. Create an idea to decode messages and enable a suitable reply in the same manner. 4. Identify and construct phrases, and other vocabulary. 5. Analyse their language, culture, music, food and other aspects of the Korean Language.												
Prerequisites: Plus Two -Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-		
CO2	-	-	-	-	-	-	-	2	2	3	-	-		
CO3	-	-	-	-	-	-	-	-	-	3	-	-		
CO4	-	-	-	-	-	-	2	-	-	3	2	-		
CO5	-	-	-	-	-	-	-	-	2	3	2	3		
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 – Introduction: Language and Culture (6L)														
What kind of language is Korean? Korea, philosophy of the Korean language & GangNam Style! In this module, students will learn Korean culture, philosophy of creating Korean scripts, and the Korean alphabet or Korean writing system called 'Hangeul'. After completing the lessons, students will be able to understand the principles how each letter													CO-1 BTL-1	

was invented. Also, students will be able to understand Korean sign languages as well.		
Suggested Activities: Memory game		
MODULE 2 – HANGEUL		(6L)
Greetings and Introducing phonics, the character system, Noun, Pronoun Basic Verb and Greetings & Introducing. In this module, Students will learn how to greet, ask someone's nationalities / jobs and answer those questions in Korean. After completing the lessons, students will be able to introduce themselves, greet a person and talk about someone's nationalities and occupations. Suggested activities: Introducing, Game with song, Flash cards game		CO-2 BTL-2
MODULE – 3 : Restaurant & Shopping		(6L)
Reading simple sentence - to be able to comprehend sign board and name, ordering at arestaurant, counting units, Interrogative sentence. In this module, students will learn how to order food and make requests at a restaurant in Korean. After completing the lesson, students will be able to inquire about restaurant menus, order a specific portion of food at a restaurant, and order a drink at a café. After completing the lesson, you will be able to express prices per item, purchase a product from a store, and make a specific request while shopping. Suggested Activities: Playing in the condition of restaurant and Shop, Dictation		CO-3 BTL-3
MODULE – 4 : Daily Life & Time		(6L)
Talking about daily life, expressing movement, memo, simple message, object marker, expression of negation, & writing. In this module, students will learn various Korean vocabulary regarding your daily lives. After completing the lessons, students will be able to utilize informal sentence endings, ask and answer about their everyday life. Students will learn about time and date in Korean. And students will also say the days of the week as well. After completing the lessons, students will be able to ask and respond time & date using Korean numbers. Suggested activities: Songs about numbers and family		CO-4 BTL-2
MODULE 5 : MODULE - 5 : Speaking and interaction with Natives		(6L)
Self–Introduction, conversations, finding out information about friends, talk with Korean, visit aKorean market or company. K-POP! Students are able to successfully handle a limited number of uncomplicated communicativetasks related to predictable topics for survival in Korea. Suggested Activities: Talk with Native Korean		CO-5 BTL-3
TEXT BOOK		
1.	세종한국어 1 The National Institute of The Korean Language	
REFERENCE BOOKS		
1	[Active Korean 1] ,	
2	[Practical Korean 1]	Darakwon, Korea, Korea
3	[Korean Language for a Good Job],	Darakwon (2007), Korea
E-REFERENCES		
1	https://www.amazon.in/Korean-Made-Simple-beginners-learning-ebook/dp/B00JHT4PCE	
2	http://www.twoponds.co.kr/en/snu	
3	https://www.koreantopik.com/2017/10/1-8-sejong-korean-textbook-pdfaudio69.html	

COURSE TITLE		MANDARIN						CREDITS		2				
COURSE CODE		GLS51015		COURSE CATEGORY			HS		L-T-P-C		2-0-0-2			
Version	2.0	Approval Details		36 th ACM			LEARNING LEVEL			BTL - 3				
ASSESSMENT SCHEME														
First Periodical Assessment		Second Periodical Assessment		Seminar/ Assignments/ Project		Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”			Attendance		ESE			
15%		15%		10%		5%			5%		50%			
Course Description		This level of Mandarin language course has been programmed to understand more symbols and grammatical concepts. It simplifies the construction of sentences, making it easy to converse basic sentences. The student will be able to translate texts and also speak relating to weather, climate and self-introduction. An introduction to ‘My family’ and description using adjectives.												
Course Objectives		1. As Mandarin tops all global languages, the students get an upper hand in the prime industries of the world and direct access to the Chinese speaking community. 2. He/she will be able to create a direct connect thereby eliminating the requirement of a translator. 3. This will improve the overall personality of the student thereby making him/her more confident to communicate with global clients. 4. The course will provide survival skills to students relocating to countries where Mandarin is spoken.												
Course Outcomes		1. Learning the rules of Hanyu pinyin, pronunciation, Mandarin Chinese tones, character-based common vocabulary, fundamental grammar, and oral and writing practices. 2. Being able to differentiate the major tones of Chinese characters; Being able to differentiate the similar pronunciation of different vocabularies. 3. Practicing basic communicative skills in Mandarin Chinese; through repetition practices in class, students are to learn commonly usedChinese vocabulary, sentences structure and oral communicative skills. 4. Through in-class assignments, students are to recognize easy and basic Mandarin characters; in addition, students are to learn the regulation of expressing Mandarin Chinese in PinYin system and understand the specificadoption of borrowing from Alphabetic symbols. 5. 5. Through in-class assignments, students are to practice the drawing ofMandarin Chinese strokes order and characters												
Prerequisites: Plus Two -Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-		
CO2	-	-	-	-	-	-	-	2	2	3	-	-		

CO3	-	-	-	-	-	-	-	-	-	3	-	-		
CO4	-	-	-	-	-	-	2	-	-	3	2	-		
CO5	-	-	-	-	-	-	-	-	2	3	2	3		
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE – 1 Mandarin Chinese Character and Tones													(6L)	
Basic strokes in Chinese - commonly used radicals - formation of vocabulary -pictograms - ideograms - compound ideographs - phono-semantic compounds - derivative cognates - phonetic loans - 4 tones introduction - consonants -single vowel - double vowels - initial, medial and vowels Suggested activities: Direct lecturing, repeated themes lecturing													CO-1BT-2	
MODULE - 2 Listening Skills													(6L)	
Listening to native speaker’s pronunciation of scripts, vocabularies. Tones differentiating trainings, one character with different pronunciation or tones, different characters with the same pronunciation or tones Suggested activities: Listening to native speaker’s pronunciation and translate it into English.													CO-2BT-3	
MODULE - 3 Speaking Skills													(6L)	
Imitating native speaker’s pronunciations, tones and intonations to speaknaturally Suggested activities: Reverse teaching, presentation, formal and informal conversations, singingChinese songs, cultural activities, describing things													CO-3BT-3	
MODULE - 4 Reading Skills.													(6L)	
50 vocabularies - easy to difficult - important and commonly used - Suggested activities: Flashcards to practice, word recognition competition													CO-4 BT-3	
MODULE 5 Writing Skills													(6L)	
15 vocabularies - easy to difficult - important and commonly used - ChineseCalligraphy Suggested activities: Only practiced in assignments, not tested in any exams, composition practice(optional)													CO-5BT-3	
TEXT BOOK														
1.	National Taiwan Normal University Mandarin Training Center (2015). Linkingpublishing company. A Course in Contemporary Chinese (Textbook) 1													
REFERENCE BOOK														
1.	National Taiwan Normal University Mandarin Training Center (2017). Linking publishing company. Practical Audio-Visual Chinese Vol. 1, 3rd Edition													

MOOC REFERENCE	
1	http://chineseworksheetgenerator.org

COURSE TITLE		Japanese					CREDITS			2				
COURSE CODE		GLS51016	COURSE CATEGORY		HS		L-T-P-S			2-0-0-2				
Version	1.0	Approval	36 th ACM				LEARNING LEVEL			BTL- 3				
ASSESSMENT SCHEME														
CIA										ESE				
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”			Attendance								
15%	15%	10%	5%			5%		50%						
Course Description		This course has been designed to acquire grammar and be able to use Japanese to communicate in everyday simple and practical situations. The content of this course includes pronunciations speaking skills, listening practice and reading and writing.												
Course Objective		1. To make the students to write and speak Japanese easily in any situation, daily life and daily conversations. 2. To develop language skills and interest in learning. 3. To facilitate students to create opportunities for themselves in the society. 4. To develop the spoken language fluently. 5. To help the students to learn about the uniqueness of the Japanese Language.												
Course Outcome		Upon the completion of this course, the students will be able to 1. Demonstrate the letters and basic words of Japanese Language which are in daily use 2. Develops the listening skills of Japanese language 3. Utilize the letters and common words of the language for communication 4. Develop the conversational skills 5.Demonstrate the skill of reading and writing												
Prerequisites: Plus Two -Intermediate Level														
CO, PO AND PSO MAPPING														
CO00	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	-	3	-	-		
CO2	-	-	-	-	-	-	-	2	2	3	-	-		
CO3	-	-	-	-	-	-	-	-	-	3	-	-		
CO4	-	-	-	-	-	-	2	-	-	3	2	-		
CO5	-	-	-	-	-	-	-	-	2	3	2	3		
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 – LANGUAGE AND CULTURE												(6L)		

Greetings - -Self-Introduction - Numbers and Alphabets – Names of countries & Continents-Telling the time- Professions-Introduction about the language and country - Context based learning –At the Café, City orientation, Family, Daily routine, Weather and Clothing		CO-1 BTL-1
挨拶-自己紹介-数字とアルファベット-国と大陸の名前-時間を伝える-職業-言語と国についての紹介-コンテキストベースの学習-カフェで、都市オリエンテーション、家族、日常、天気と服装		
MODULE 2 : BASIC GRAMMAR		(6L)
Definite and indefinite articles - Simple verbs and conjugation – Pronouns-Possessive Pronoun-W Questions-Adjectives –Separable verbs		CO-2 BTL-2
明確な冠詞と不定冠詞-単純な動詞と活用-代名詞-所有代名詞-W質問-形容詞-分離動詞		
MODULE 3 : READING & LISTENING SKILLS		(6L)
Reading simple passages - to be able to comprehend advertisements and short texts - Listening comprehension of real time situation based dialogues		CO-3 BTL-3
簡単な文章を読む-広告や短いテキストを理解できるようにする-リアルタイムの状況に基づいた対話の理解を聞く		
MODULE 4 : WRITING SKILLS		(6L)
Small passages – Comprehension – Composition – Letter writing		CO-4 BTL-2
小さな文章-理解-作文-手紙の書き方		
MODULE 5 : SPEAKING SKILLS		(6L)
Introducing self- describing daily routine – engaging in dialogues about family, city, orientation, ordering food at the café and weather		CO-5 BTL-3
自己記述的な日常生活の紹介-家族、都市、オリエンテーション、カフェでの食事の注文、天気についての対話に参加する		
TEXT BOOK		
1.	Minna no Nihongo: main textbook and translation book. (second edition, Elementary level 1-1) Publisher: Goyal Publishers	
REFERENCE BOOKS		
1.	Konomi,Emiko.Begginning Japanese for Professionals:Book 1, Portland State University,2015. https://www.academia.edu/81329400/Basic_japanese_A_grammar_and_workbook	
E-REFERENCES		
	https://www.academia.edu/81329400/Basic_japanese_A_grammar_and_workbook	

COURSE TITLE	UNIVERSAL HUMAN VALUES			CREDITS	2
COURSE CODE	GGE51001	COURSE CATEGORY	HS	L-T-P-S	2-0-0-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME														
First Periodical Assessment		Second Periodical Assessment				Seminar/ Assignments/ Project		Surprise Test / Quiz		Attendance			ESE	
15%		15%				10%		5%		5%			50%	
Course Description		This course is mandatory as per the AICTE for the UG students to motivate the students for focusing on the human values. The main aim is to focus on the sustainability of happiness with harmony and natural acceptance in the career. Lecture cum power points is provided as guidelines from AICTE.												
Course Objective		1. To create awareness to students on themselves and their surroundings (family, society, nature). 2. To create responsibility among students on life in handling problems with sustainable solutions 3. To prepare the students with human relationships and human nature in mind. 4. To Prepare the students on critical ability and sensitive to their commitment. (Human values, human relationship and human society). 5. To Apply the learning to their real life.												
Course Outcome		Upon completion of this course, the students will be able to 1. Demonstrate the necessity of relationship with family, society and nature. Familiarize with the challenges ahead and proposed solutions. 2. Formulate and design human cyber security policies, plans and procedures for organizations. 3. Apply standard security countermeasure tools to sustain human relationships and nature.es. 4. Recognize the necessity of human values and relationship. 5. Demonstrate the learning in their real life.												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO - 10	PO- 11	PO- 12	PSO -1	PSO -2
CO-1	1	1	1	1	1	2	2	3	2	2	1	3	-	-
CO-2	1	1	1	1	1	2	2	3	2	2	1	3	-	-
CO-3	1	1	1	1	1	2	2	3	2	2	1	3	-	-
CO-4	1	1	1	1	1	2	2	3	2	2	1	3	-	-
CO-5	1	1	1	1	1	2	2	3	2	2	1	3	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Introduction													(6L)	
Need, Basic Guidelines, Content and Process for Value Education Purpose and motivation for the course, recapitulation from Universal Human Values-I Self-Exploration—what is it? - Its content and process; ‘Natural Acceptance’ and experiential Validation- as the process for self-exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Practical component: Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking Suggested Readings: Evolution of cyber security													CO-1 BTL-2	
MODULE 2: Understanding Harmony in the Human Being													(6L)	

Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body' Understanding the needs of Self ('I') and 'Body' - happiness and physical facility Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail -Programs to ensure Sanyam and Health. Practical component: Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease	CO-2 BTL-2
MODULE 3: Understanding Harmony in the Family and Society (6L)	
Harmony in Human-Human Relationship- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship - Understanding the meaning of Trust; Difference between intention and competence Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals Practical component: Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives	CO-3 BTL-3
MODULE 4: Understanding Harmony in the Nature and Existence (6L)	
Whole existence as Coexistence - Understanding the harmony in the Nature -Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature -Understanding Existence as Co-existence of mutually interacting units in all-pervasive space -Holistic perception of harmony at all levels of existence. Practical component: Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.	CO-4 BTL-2
MODULE 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics (6L)	
Natural acceptance of human values, Definitiveness of Ethical Human Conduct Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order -Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. -Case studies of typical holistic technologies, management models and production systems -Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. Sum up. Practical component: Include practice exercises and case studies to discuss the conduct as an engineer or scientist etc.	CO-5 BTL-2
TEXT BOOKS	
1. P.R Gaur, R Asthana, G.P Bagaria, Human Values and Professional Ethics (2nd revised edition) Excel Books, New Delhi, 2019 2. A Nagaraj, Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amarkantak, 1999. 3. A. N Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004. Lawrence, C. (2016). <i>Cyber security for Dummies</i>, John Wiley & Sons Inc., 2nd Edition, pp.213--432.	
REFERENCE BOOKS	

1.	AICTE STUDENT INDUCTION PROGRAM HANDBOOK- https://fdp-si.aicte-india.org/download/G012%20SIP%20Hand%20Book%20v2.pdf
E BOOKS	
1.	https://fdp-si.aicte-india.org/download.php#1

COURSE TITLE		தமிழ் கலாச்சாரமும் தொழில்நுட்பமும் (TAMIL CULTURE AND TECHNOLOGY)		CREDIT	1	
COURSE CODE	GLS51017	COURSE CATEGORY		HS	L-T-P-S	1-0-0-2
VERSION	1.0	APPROVAL DETAILS		35 th ACM	LEARNING LEVEL	BTL- 4
ASSESSMENT SCHEME						
FRIST PERIODICAL ASSESSMENT	SECOND PERIODICAL ASSESSMENT	SEMINAR/ASSIGNMENTS /PROJECTS		SURPRISE TEST/QUIZ	ATTENDANCE	ESE
15%	15%	10%		5%	5%	50%
பாட விளக்கம்	தமிழர்களின் வரலாறு மற்றும் கலாச்சார மரபுகளைப் படிப்பதன் மூலம் மாணவர்களுக்கு மொழித்திறன் ஆற்றல் நன்கு வளர்ச்சி அடைகிறது. மேலும் மாணவர்களிடையே மொழிப்பற்று உருவாகி கற்றலில் ஆர்வம் அதிகரிக்கிறது. இப் பாடத்திட்டத்தில் செய்யுள், இலக்கிய வரலாறு, நாகரிகம், பண்பாடு, பண்டையத் தமிழர்களின் உணவு, உடை, உறையுள், அணிகலன், போர் முறை, பண்டையத் தமிழரின் மரபு பற்றிய செய்திகள் அடங்கியுள்ளன. களவு ஒழுக்கம், கற்பு ஒழுக்கம் ஆகியவற்றை மாணவர்கள் கற்பதன் மூலம் வாழ்க்கைக்குத் தேவையான ஒழுக்க நெறிமுறைகள் நன்கு வளர்ச்சியடையும்.					
பாடத் திட்டத்தின் நோக்கம்	இப் பாடத்திட்டத்தின் மூலம் சமுதாயத்தில் தங்களுக்குத் தேவையான வாய்ப்புக்களை மாணவர்கள் உருவாக்கிக்கொள்ள வழிவகைச் செய்கிறது. அத்துடன் சமய வழிபாடு, விழாக்கள், சடங்குகள், நம்பிக்கைகள், மந்திரம், விளையாட்டுகள், தொழில்கள், வாணிகம் முதலியச் செய்திகளைக் கற்பதன் மூலமாக மாணவர்களிடையே புகுத்தாயும் திறன் நன்கு வளர்ச்சியடைகிறது. இப்பாடத்திட்டதினைக் கற்பதன் மூலம் மொழித்துறையில் ஆர்வம் ஏற்பட்டுத் தமிழ் இலக்கியங்களைப் பற்றியத் தேடல் மாணவர்களிடம் அதிகரிக்கிறது.					
பாடத் திட்டத்தின் பயன்கள்	இந்தப் பாடத்திட்டத்தில் பண்டையத்தமிழரின் கட்டிடக்கலை, இசைக்கலை, சிற்பக்கலை, ஓவியக்கலை, நாடகக்கலை, அறிவியல், மருத்துவம், வானியல், வானூர்தியியல், கனிமவியல், உயிரியல், எண்ணியல் முதலிய தொழில்நுட்பம் சார்ந்த தகவல்கள் இணைக்கப் பட்டிருப்பதால் மாணவர்களிடம் உளவியல் ரீதியான நுண்ணறிவுத் தேடலை ஏற்படுத்தி எதிர்கால வேலை வாய்ப்பிற்கு உந்து சக்தியாக அமையும். பண்டையக் காலத் தொழில்நுட்பக் கருவிகள், தொழில்நுட்ப எந்திரங்கள், இன்றைய கணினித்தமிழ், இணையமும் தமிழும், தகவல் தொடர்பியல் மற்றும் ஊடகவியல் முதலியன இப்பாடத்திட்டத்தில் இணைக்கப்பட்டிருப்பது மாணவர்களிடையே தொழில்நுட்ப திறனை வளர்க்கும். மாணவர்கள் மொழித்திறனை வளர்த்துக்கொண்டு தெளிவான முறையில் கவிதை, கட்டுரை, சிறுகதைப் போன்றவைகளைப் படிப்பதிலும், படைப்பதிலும் ஆர்வம் செலுத்தி சிறந்த படைப்பாளராக உருவாகி சமுதாய வளர்ச்சிக்குத் தேவையான பல நல்ல படைப்புக்களைக் கொடுக்கும் வகையில் பாடத்திட்டம் அமைக்கப்பட்டுள்ளன. மாணவர்கள் ஒழுக்க நெறியோடு தங்களின் வாழ்க்கைத் தரத்தை மேம்படுத்திக் கொள்ளவும், பண்டையத் தமிழர்களின் வாழ்கை முறை, பண்பாடு, கலாச்சாரம், நாகரிக வளர்ச்சி, தொழில்நுட்பம் ஆகியவற்றைக் கற்றுக்கொண்டு மாணவர்கள் தங்களின் வாழ்க்கைத் தரத்தை மேம்படுத்திக் கொள்ள இந்த பாடத்திட்டம் உறுதுணையாக அமைந்துள்ளது.					
Prerequisites: Plus Two Tamil-Intermediate Level						

CO, PO AND PSO MAPPING															
CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO -10	PO-11	PO-12	PSO-1	PSO-2	
CO-1	-	-	-	-	-	-	-	-	-	3	-	-			
CO-2	-	-	-	-	-	-	-	2	2	3	-	-			
CO-3	-	-	-	-	-	-	-	-	-	3	-	-			
CO-4	-	-	-	-	-	-	2	-	-	3	2	-			
CO-5	-	-	-	-	-	-	-	-	2	3	2	3			
1: Weakly related, 2: Moderately related and 3: Strongly related															
அலகு - அலகு -1 மொழி மற்றும் இலக்கியம் (3L)															
மொழி - செம்மொழி - சங்க இலக்கியம் - பண்டைத் தமிழர்களின் உணவு - உடை - உறையுள் - அணிகலன் - போர்முறை - தமிழ் காப்பியங்கள் - பக்தி இலக்கியம் - நவீன இலக்கியத்தின் வளர்ச்சி - பாரதியார், பாரதிதாசன், கவிமணி, நா.முத்துக்குமார். வகுப்பறை செயல்முறைகள் : 1. விரிவுரை முறை 2. வினா - விடை முறை 3. குழுவிவாதம் 4. வகுப்பறை தேர்வு இதுப்போன்ற வகுப்பறை செயல்முறைகளைக் கொடுத்து மாணவர்களிடம் கற்றலில் ஆர்வத்தை ஏற்படுத்துதல்														CO-1 BTL-2	
அலகு-2 கலைகள் (3L)															
நாடகக்கலை - (அறிமுகம்) - தெருக்கூத்து - தோல்பாவை - ஓயிலாட்டம் -மயிலாட்டம் - கரகாட்டம் - புலியாட்டம் - சிலம்பாட்டம் - இசைக்கலை - சிற்பக்கலை - ஓவியக்கலை. வகுப்பறை செயல்முறைகள்: 1. விளக்கவுரை 2. வினா எழுப்புதல் 3. பாடல்கள் அல்லது கவிதை சொல்லுதல் 4. கதைச் சொல்லுதல் 5. ஒப்படைப்பு கொடுத்தல் இதுப் போன்ற வகுப்பறை செயல்முறைகளைக் கொடுத்து மாணவர்களிடம் கற்றலில் ஆர்வத்தை ஏற்படுத்துதல்.														CO-2 BTL-3	
அலகு -3 உற்பத்தி தொழில்நுட்பம் (3L)															
உலோகவியல் - இரும்புத் தொழிற்சாலை - நாணயங்கள் - அச்சடித்தல் -மணிகள் உருவாகுதல் - தொல்லியல் சான்றுகள் - நெசவுத்தொழில் -மண்பாண்டங்கள் செய்தல் - ஜவகை நிலங்களின் தொழிகள் - (முதற்பொருள்-கருப்பொருள்). வகுப்பறை செயல்முறைகள்: 1. விளக்கவுரை அளித்தல் 2. வினா எழுப்புதல் 3. வகுப்பறை குழுவிவாதம் 4. வினாடி - வினா நிகழ்வு நடத்துதல் இதுப்போன்ற வகுப்பறை செயல்முறைகளைக் கொடுத்து மாணவர்களிடம் கற்றலில் ஆர்வத்தை ஏற்படுத்துதல்.														CO-3 BTL-3	
அலகு -4 வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம் (3L)															

அருவி - ஆறு - ஏரி - அணை - குளங்கள் - கால்நடை பராமரிப்பு - மீன்வளம் - தொழில்சார் அறிவியல் சமூகம் - சொட்டுநீர் பாசனம் - தெளிப்புநீர் பாசனம். வகுப்பறை செயல் முறைகள்: 1.வினா எழுப்புதல் 2. மின்னல் அட்டைகள் காண்பித்தல் 3. வகுப்பறை குழுவிவாதம் 4. வகுப்பறை தேர்வு	CO-4 BTL-1
அலகு -5 அறிவியல் மற்றும் கணினித்தமிழ் (3L)	
கணினித்தமிழ் - தோற்றம் - வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்புச் செய்தல் - மென்பொருள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின்நூலகம் - இணையத்தமிழ் அகராதிகள் - சொற்குவை திட்டம். வகுப்பறை செயல் முறைகள்: 1. விளக்கவுரை அளித்தல் 2. காட்சி விளக்கப்படங்கள் 3. பட்டிமன்றம் 4. கணினியில் தமிழ் செயல்முறைகள்	CO-5 BTL-2
பாடப்புத்தகம்	
1.பண்டைத் தமிழ் நாகரிகமும் பண்பாடும், ஞா.தேவநேயபாவாணர், தமிழ்மண் பதிப்பகம், சென்னை. 2000. 2. பழந்தமிழில் அறிவியல், க.பலராமன், உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை. 2009. 3. தமிழக வரலாறும் மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும்) 4. கணினித்தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)	
பார்வை நூல்கள்	
1. அ. , 2014, தமிழர் நாகரிகமும் பண்பாடும், யாழ் வெளியீடு, மேற்கு அண்ணா நகர், சென்னை-40, 2. மயிலை சீனி வேங்கடசாமி, 2014, நுண்கலைகள், பூம்புகார் பதிப்பகம், சென்னை-08,. 3. க.மங்கையர்க்கரசி , 2017,பழந்தமிழ் இலக்கியங்களில் அறிவியல் சிந்தனைகள், லாவண்யா பதிப்பகம், திருவல்லிக்கேணி, சென்னை-05, 4. துரை.மணிகண்டன் ,இணையமும் தமிழும், நன்னிலம் பதிப்பகம், சென்னை.	
மின் நூல்கள்	1. www.tamilvu.org 2. www.projectmadurai.org 3. www.tamilnoolagam.in

COURSE TITLE	TAMIL CULTURE AND TECHNOLOGY தமிழ் கலாச்சாரமும் தொழில்நுட்பமும்			CREDIT	1
COURSE CODE	GLS51017	COURSE CATEGORY	HS	L-T-P -S	1-0-0-2
VERSION	1.0	APPROVAL DETAILS	35 TH ACM	LEARNING LEVEL	BTL- 4
ASSESSMENT SCHEME					
FRIST PERIODICAL ASSESSMENT	SECOND PERIODICAL ASSESSMENT	SEMINAR/ASSIGNEMNTS/P ROJECTS	SURPRISE TEST/QUIZ	ATTENDANCE	ESE
15%	15%	10%	5%	5%	50%

Course Description	- By studying the history and cultural traditions of the Tamil, the language skills of the students are well developed. Also, the interest in learning increases and develops a passion for the language among the students. - This syllabus contains information about Literary History, Civilization, Culture, Ancient Tamil Food, Dress, Clothing, Ancient War System and Tamil Tradition. - By learning about theft and chastity, students will be able to develop good moral values in life.
Course Objective	- Through this curriculum the students are empowered to create opportunities for themselves in the society. Also, by learning about religious worship, ceremonies, rituals, beliefs, mantra, sports, professions, commerce, etc., analytical skills are well developed among the students. - By learning this syllabus, the interest in the field of language and the search for learning about Tamil literature increases in the students.
Course Outcome	- In this syllabus, the technical information related to ancient Tamil architecture, music, sculpture, painting, dance, drama, ancient science thinking, are incorporated to develop the psychological intelligence skills of the students. It creates and becomes a driving force for future employment. - The inclusion of ancient technological tools and technological machines in present-day computer Tamil, Internet and Tamil, information communication and media studies in the curriculum develops technical skills among the students. - The curriculum has been set up so that the students develop their language skills and take interest in reading and writing poems, essays, short stories, etc. in a clear manner and develop into great creators and provide many good works needed for the development of society. - This curriculum helps the students to improve their quality of life with discipline and learn about the way of life, tradition, culture, civilization and technology of the ancient Tamil.

Prerequisites: Plus Two Tamil-Intermediate Level

CO, PO AND PSO MAPPING

CO	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	-	-	-	-	-	-	-	-	-	3	-	-		
CO-2	-	-	-	-	-	-	-	2	2	3	-	-		
CO-3	-	-	-	-	-	-	-	-	-	3	-	-		
CO-4	-	-	-	-	-	-	2	-	-	3	2	-		
CO-5	-	-	-	-	-	-	-	-	2	3	2	3		

1: Weakly related, 2: Moderately related and 3: Strongly related

அலகு -	UNI T – 1 LANGUAGE AND LITERATURE	(3 Hours)
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Language - Classical - Sanga Literature - Ancient Tamils, Food – Costume – Clothing – Martial Arts - Tamil Copies - Bhakti Literature - Development of Modern Literature - Bharathiyar and Bharathidasan – Kavimani - N.Muthukumar. Classroom Procedures: 1. Lecture Method 2. Question-Answer Method 3. Group discussion 4. Classroom test	CO-1 BTL-2
Unit - 2 Tamil Arts (3 Hours)	
Drama - (Introduction) – Terukoothu - Dholpavai – Violatam – Karakatam – Mayilatam – Puliyatam – Silambattam – Music – Sculpture – Painting Classroom Procedures: 1. Explanation 2. Questioning 3. Recitation of songs or poetry 4. Story telling Insists interest in learning among students by giving such classroom processes.	CO-2 BTL-3
Unit –3 Manufacturing Technology (3 Hours)	
Metallurgy - Iron industry – Coins – Printing - Bead making - Archaeological Evidence - Weaving – Carpentry - Industries of five types of lands - (Primary material - Theme). Classroom Procedures: 1. Presentation 2. Questioning 3. Classroom group discussion 4. Conduct a quiz event Instill interest in learning among students by giving such classroom processes.	CO-3 BTL-3
Unit - 4 Agriculture and Irrigation Technology (3 Hours)	
Dam – lake – ponds - livestock maintenance – fisheries - knowledge community - drip irrigation Classroom Activities: 1. Questioning 2. Displaying lightning cards 3. Classroom group discussion 4. Classroom test	CO-4 BTL-1
Unit – 5 Science Tamil and C Tamil Computing (3 Hours)	
Computerized Tamil Development – E- Printing of Tamil Texts - Software Development – Tamil Internet Education Institute - Tamil e – Library - Internet Tamil Dictionaries -Vocabulary Project Classroom Activities: 1. Presentation 2. Visual charts 3. projector show in the class room 4. Tamil processes in computer	CO-5 BTL-2

TEXT BOOK	
	1. Ancient Tamil Civilization and Culture, J. Devaneyapa Bhavanar, A. Nakkiran (P.A.), Tamilman Publishing House, Chennai. 2000. 2. Palantamil Science, K. Balaraman, World Tamil Research Institute, Chennai. 2009. 3. Tamil History-People-Culture-KKPillai (Exhibit Tamil Nadu Textbook and) 4. Computer Tamil-PhD I. Sundaram (Vikatan Publications)
Reference books	
	1. A. Dakshinamurthy, 2014, Tamil Civilization and Culture, Jaffna Publication, West Anna Nagar, Chennai-40. 2. Mailai Seeni Venkatasamy, 2014, Fine Arts, Boombukar Publishing House, Chennai-08. 3. K. Mangaiyarkaras, Scientific, 2017, Thoughts in Ancient Tamil Literature, Lavanya Publishing House, Thiruvallikeni, Chennai-05. 4. Durai. Manikandan. Sundaram Internet and Tamil, 2014, Computer Tamil Nannilam Publishing House, Chennai.
E-BOOKS	1. www.tamilvu.org 2. www.projectmadurai.org 3. www.tamilnoolagam.in

Semester-II

COURSE TITLE	ANALYTICAL MATHEMATICS			CREDITS	4	
COURSE CODE	EMA51002	COURSE CATEGORY		BS	L-T-P-S	3-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination (Theory)	End Semester Examination (Practical)
15%	15%	10%	5%	5%	25%	25%
Course Description	To make the student understand the basic analytical mathematical skills that is imperative for effective understanding of engineering subject using MATLAB.					
Course Objective	1. To implement problem solving skills using vectors 2. To provide an exposure on the concepts of complex variables, conformal mapping and bilinear transformation. 3. To comprehend integrals using Cauchy’s integral and residue theorem. 4. To illustrate the applications of Laplace Transforms 5. To make the students understand the concept of Fourier series					
Course Outcome	Upon completion of this course, the students will be able to 1. Verify the standard theorems in Vector Calculus and apply them to evaluate surface area and volume. 2. Construct an analytic function when real and imaginary parts are given. 3. Evaluate finite integrals using Cauchy’s theorem. 4. Solve the system of ordinary differential equations using Laplace Transform					

5. Expand the Fourier series for the given function.														
Prerequisites: Knowledge in single-variable calculus.														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PSO -2
CO-1	3	3	2	-	1	-	-	-	-	-	-	1	2	1
CO-2	3	2	1	-	2	-	-	-	-	-	-	1	1	1
CO-3	3	2	1	2	1	-	-	-	-	-	-	1	2	2
CO-4	3	3	2	1	1	-	-	-	-	-	-	2	1	1
CO-5	3	3	2	-	1	-	-	-	-	-	-	2	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: VECTOR CALCULUS (9L+6P)														
Gradient, Divergence and Curl – Unit normal vector, Directional derivative – angle between surfaces- Irrotational and Solenoidal vector fields. Green’s theorem - Gauss divergence theorem and Stoke’s theorem (without proof) – Verification and evaluation of the above theorems - Simple applications to regions such as square, rectangle, triangle, cuboids and rectangular parallelopipeds. Suggested Reading: Basics of Vectors Lab: Gradient, Divergence, Curl, Irrotational and Solenoidal vector fields												CO-1 BTL-3		
MODULE 2: COMPLEX VARIABLES (9L+6P)														
Functions of a complex variable – Analytic function - Cauchy - Riemann equations – Properties of analytic function (Statement Only) – Construction of Analytic functions by Milne – Thomson method – Conformal Mapping – Mapping by functions $w = z + c, w = cz, w = 1/z$, Bilinear transformation. Suggested Reading: Complex Numbers Lab: Verification of Analytic Function												CO-2 BTL-3		
MODULE 3: COMPLEX INTEGRATION (9L+6P)														
Statement and Application of Cauchy’s Integral theorem and integral formula (without proof)-Evaluation of integrals using the above theorem-Taylor and Laurent series expansions-Singularities-Classification. Residues-Cauchy’s residue theorem (without proof)-Contour integration over unit circle and semi-circular contours (excluding poles on boundaries) Suggested Reading: Types of integration Lab: Evaluation of integrals using Cauchy’s Integral formula and Cauchy’s residue theorem.												CO-3 BTL-3		
MODULE 4: LAPLACE TRANSFORMS (9L+6P)														
Laplace transform – Conditions of existence – Transform of elementary functions – properties – Transforms of derivatives – Initial and final value theorems – Transform of periodic functions. Inverse Laplace transforms using partial fraction and convolution theorem. Solution of linear ODE of second order with constant coefficients. Suggested Reading: Basics of Transform Lab: Solutions of differential equations using Laplace transform												CO-4 BTL-3		
MODULE 5: FOURIER SERIES (9L+6P)														

Dirichlet's Conditions – General Fourier Series – Odd and even functions – Half range sine and cosine series –Harmonic Analysis. Suggested Reading: Basics of series Lab: Finding Fourier Series		CO-5 BTL-3
TEXT BOOKS		
1.	A. Chandrasekaran, G. Kavitha (2022), <i>Analytical Mathematics</i> , Dhanam Publications, 1 st Edition, Chennai.	
2.	T. Veerarajan (2016), <i>Engineering Mathematics-II</i> , McGraw Hill Education (India), Private Limited, 4 th Edition, New Delhi.	
3.	Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma (2016), <i>MATLAB and its Applications in Engineering</i> , Pearson Publication, 2 nd Edition, New Delhi.	
4.	D. G. Duffy (2021), <i>Advanced Engineering Mathematics With MATLAB (Advances in Applied Mathematics)</i> , Chapman and Hall Publisher, 5 th Edition, CRC Press, USA.	
REFERENCE BOOKS		
1.	P. Sivarama Krishna Das, C. Vijayakumari (2017), <i>Engineering Mathematics</i> , 1 st Edition, Pearson Publishing, Chennai.	
2.	A. P. Santhakumaran, P. Titus P (2017), <i>Engineering Mathematics – II</i> , NiMetric Publications, 2 nd Edition, Nagercoil, India.	
3.	Kreyszig Erwin (2016) <i>Advanced Engineering Mathematics</i> , John Wiley and Sons, 10 th Edition, New Delhi.	
4.	S.S. Sastry (2015), <i>Engineering Mathematics</i> , Vol. I & II, PHI Learning Pvt. Ltd, 4 th Edition, New Delhi.	
E BOOKS		
1.	http://ggn.dronacharya.info/APSDept/Downloads/QuestionBank/Mathematics-I/SectionD.pdf .	
2.	https://people.math.sc.edu/girardi/m7034/book/AshComplexVariablesWithHyperlinks.pdf	
3.	https://ocw.mit.edu/courses/18-03sc-differential-equations-fall-2011/pages/unit-iii-fourier-series-and-laplace-transform/	
4.	https://www.pdfdrive.com/calculus-ii-sequences-and-series-e11676778.html	
MOOC		
1.	https://www.edx.org/course/introduction-engineering-mathematics-utarlingtonx-engr3-0x	

COURSE TITLE		Advanced Communication Skill			CREDITS	1	
COURSE CODE		GLS51019	COURSE CATEGORY		HS	L - T - P - S	3- 0-0- 1
Version	01	Approval Details		42 nd ACM, 26 th Oct. 2024		LEARNING LEVEL	BTL -4
ASSESSMENT SCHEME							
CIA							ESE
First Periodical Assessment	Second Periodical Assessment	Assignments as approved by the Department Examination Committee “DEC”		Surprise Test / Quiz., as approved by the Department Examination Committee “DEC”		Attendance	Theory
15 %	15 %	10 %		5 %		5 %	50 %

Course Description	This course is designed to help students develop and refine their communication skills at an advanced level. Through interactive workshops, case studies, and practical exercises, students will learn strategies to communicate effectively in a variety of professional and social settings. Topics covered include persuasive public speaking, leading productive meetings and presentations, negotiating and influencing skills, intercultural communication, and mastering nonverbal communication. Students will have the opportunity to receive personalized feedback and coaching to polish their communication style and increase their confidence. By the end of the course, participants will be equipped with a toolkit of advanced communication techniques to excel in their careers and interpersonal interactions.													
Course Objective	1. To acquire self-confidence by which the learner can improve upon their informative listening skills by an enhanced acquisition of the English language. 2. To provide an environment to Speak in English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate. 3. To equip the students to Read, comprehend and answer questions based on literary, scientific and technological texts. 4. To enhance the writing skills of the students via training in instructions, recommendations, checklists, process-description, letter-writing and report writing. 5. To equip the learners in analyzing and applying creative thinking skills and participate in brainstorming, mind-mapping, audiovisual activities and excel in employability skills.													
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the ability to construct the grammatically correct sentences with accuracy and syntax structures. 2. Integrating various components of English Language and determining it through reading and listening. 3. Analyze and transcode data, construct different types of written essays, read complex passages and summarize ideas, create personal profiles in the form of a resume. 4. Organize and articulate ideas, concepts, and perceptions in a comprehensive manner in written business correspondence, and speaking in formal and informal situations. 5. Infer details about presentation skills and implementing it in various professional situations.													
Prerequisites: Plus Two English-Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	1	1
CO2	-	-	-	-	-	-	-	2	2	3	-	-	0	0
CO3	-	-	-	-	-	-	-	-	-	3	-	-	1	1
CO4	-	-	-	-	-	-	2	-	-	3	2	-	0	1
CO5	-	-	-	-	-	-	-	-	2	3	2	3	1	0
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE1: Talk about different cultures													(9L)	
Grammar : Modals of Obligation – Comparatives and Superlatives – Asking for and Giving Recommendations - Writing : Two Reviews Positive and Negative Language Adverbs. Reading: Article: Culture Shock, There’s an app to deal with that - Blog: Hungry Adventures, - Reviews of Café. Pronunciation : Word Stress : compound nouns 2. Sound and Spelling: /S/ and /tS/ - Sounding Interested													CO-1 BTL-2	
LAB: (Listening) Three monologues : Culture shock - Radio show : Vending Machines in Japan, - A Special Gift - Three Monologues :Special Occasions (Speaking) Describing Different Cultures - Describing a Special Meal - Asking for and giving recommendations : Expressing Surprise. - Places to go out.														

MODULE 2 : House and Home		(9L)
Grammar: Modals of deduction - Quantifiers - Making offers and requests and asking for permissions Vocabulary : Buildings - Verbs and Prepositions Pronunciation : Modal Verbs: final /t/ and /d/ sounds – Sentence stress verbs and prepositions - Sounding polite Writing : A note with useful information offering choices. Reading : Articles : Web Page : A More personal place to stay - Web page : five Reasons why small towns are better than cities. - Top five things to do in and around Miami, Florida; a note. LAB (Listening) : Four monologues : describing buildings – Conversation : Comparing life in a town and a city - Visiting a friend’s family – Conversation: a holiday in Florida (Speaking) : A note with useful information offering choices.		CO-2 BTL-3
MODULE 3 : Information		(9L)
Grammar : Reported Speech – Verb Patterns - Generating and being Vague Vocabulary : Sharing information - Reporting Verbs Pronunciation : Sound and spelling /g/ and /k/ - sound and spelling :/h/ and /w/ Writing : An email about a news story summarizing information Reading : Articles : Thinking of making a podcast? Just give it a try! - The Restaurant that wasn’t there - A news Story LAB : (Listening) : Podcast : Pod – on – pod - Interview : fake reviews – A job Interview - Monologue: A news story. (Speaking) : Giving Opinions about podcasts – Describing experiences using reporing verbs. – Generalising being vague - Air Travel.		CO-3 BTL-3
MODULE 4 : Entertainment		(9L)
Grammar : The passive - Defining and non-defining relative clauses - recommending and responding to recommendations Vocabulary : -ed / -ing adjectives – Music; Word Building(nouns) Pronunciation : Sound and spelling: final – ed in adjectives – relative clauses ; pausing word stress – showing contrast Writing : An article about a form of entertainment Contrasting ideas, the structure of an article. Reading : Articles on Business abroad LAB : (Listening) : Conversation : Film trailers - Three monologues: Musical experiences - Planning an evening out – Two monologues : live music (Speaking) : Recommending a film or TV programme – A musical experience - Recommending and responding; Asking someone to wait - Live vs recorded music		CO-4 BTL-3
MODULE 5 : Opportunities		(9L)
Grammar : Second Conditional – third conditional – Talking about possible problems and reassuring someone Vocabulary : Sport ; Adjectives and prepositions – Expressions with do, make and take Pronunciation : Sentence stress: would – Sentence stress : would and . have – sounding sure and unsure Writing : An email with advice advising a course of action Reading : Article : Searching for serendipity - A web page about volunterring: Emails Giving advice. LAB : (Listening) : Conversation: trying new activities - Making a marriage proposal – Monologue: Volunteering. (Speaking) : Taking New opportunities - A past event that made life better – Talking about possible problems and reassuring someone; changing the subject – volunteering.		CO-5 BTL-4
TEXT BOOKS		
1	Doff, A., Thaine, C., Puchta, H., Stranks, J., & Lewis-Jones, P. (2023). <i>Empower Second Edition</i> . Cambridge University Press & Assessment. New Delhi.	
REFERENCE BOOKS		
1	Murphy, Raymond(2019). <i>Intermediate English Grammar</i> . Cambridge University Press. India. (Pages 350)	
2	Barnes, D., (2020). <i>Exploratory talk for learning in Mercer, N. and Hodgkinson, S. (eds) Exploring Talk in School</i> . London: Sage Publications. (Pages 208)	
3	Dhanavel. S P (2018). <i>English and Soft Skills</i> . Orient BlackSwan. India. (Pages 136)	
4	Goldsmith, Marshall &M.S. Rao.(2020) <i>Soft Skills: Enhancing Employability</i> . Dreamtech Press. India (Pages 256)	
E Books		

1	https://www.pdfdrive.com/basic-english-grammar-with-exercises-e12486779.html
2	http://dspace.vnbrims.org:13000/jspui/bitstream/123456789/4733/1/Leadership%20The%20Power%20of%20Emotional%20Intellegence.pdf
MOOC Courses	
1	https://www.edx.org/professional-certificate/ritx-communication-skills
2	https://www.coursera.org/specializations/people-and-soft-skills-for-professional-success

COURSE TITLE		MECHANICS OF RIGID BODIES						CREDITS		4				
COURSE CODE		EAT51001		COURSE CATEGORY		PC		L-T-P-S		2-1-2-2				
VERSION	1.0			APPROVAL DETAILS		36 th ACM		LEARNING LEVEL		BTL-4				
ASSESSMENT SCHEME														
CIA										ESE				
First Periodical Assessment	Second Periodical Assessment		Seminar/ Assignments/ Project		Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”		Attendance		Theory		Practical			
15%	15%		10%		5%		5%		25%		25%			
Course Description	This course will provide knowledge on statics of particle and rigid bodies in planar and special coordinates. This course will also impart knowledge on analysis of forces on trusses and frames. In addition to that knowledge on center of gravity and moment of inertia calculation for surfaces and solids are also included. Finally, the dynamic analysis of particle in both kinematics and kinetics are also included in this course.													
Course Objectives	1. To apply concept on force analysis and equilibrium of a particle in plane and space 2. To educate the condition of equilibrium of a rigid body in plane and space 3. To impart knowledge on center of gravity and moment of inertia for planar areas and volumes 4. To instruct on force analysis in different structures such as trusses and frames 5. To educate kinematics and kinetics of particles													
Course Outcomes	Upon completion of this course, the students will be able to 1. Apply the condition of equilibrium of a particle in plane and space 2. Analyze the condition of equilibrium of a rigid body in plane and space 3. Determine the center of gravity and moment of inertia for planar areas and volumes 4. Conduct force analyze on trusses and structures 5. Analyze position, velocity, acceleration, and forces that cause the motion of particles													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	1	2	2	1	1	-	-	-	1	3	3	1
CO-2	3	2	2	3	2	1	-	-	-	-	-	3	2	2
CO-3	2	3	3	2	1	2	1	-	-	-	-	2	2	2

CO-4	2	2	3	2	1	1	-	-	-	-	1	3	3	1
CO-5	3	3	3	3	2	1	1	-	-	-	1	2	2	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Statics of Particles													(6L+3T+6P)	
Fundamental Concepts and Principles - Systems of Units. Forces in a Plane - Force on a Particle – Force as Vector - Resultant of Two Forces - Resultant of Several Concurrent Forces - Resolution of a Force into Components - Rectangular Components of a Force - Unit Vectors - Equilibrium of a Particle – Free-Body Diagram. Forces in Space - Rectangular Components of a Force in Space - Force Defined by Its Magnitude and Two Points on Its Line of Action - Resultant of Several Concurrent Forces in Space - Equilibrium of a Particle in Space. Suggested Reading: Vector and Scalar Operations													CO-1 BTL-3	
Module 2 – Statics of Rigid Bodies													(6L+3T+6P)	
Rigid Bodies: Equivalent Systems of Forces - External and Internal Forces - Principle of Transmissibility - Equivalent Forces - Moment of a Force about a Point - Varignon’s Theorem - Moment of a Force about a Given Axis - Moment of a Couple - Reduction of a System of Forces to One Force and One Couple. Equilibrium of Rigid Bodies - Equilibrium of a Rigid Body in Two Dimensions - Reactions at Supports and Connections for a Two-Dimensional Structure - Statically Indeterminate Reactions Suggested Reading: Equilibrium of a Rigid Body in Three Dimensions - Reactions at Supports and Connections for a Three-Dimensional Structure.													CO-2 BTL-4	
Module 3 – Distributed Forces: Center of Gravity and Moment of Inertia													(6L+3T+6P)	
Centroids and Centers of Gravity -First Moments of Areas and Lines - Determination of Centroids for Areas and Lines by Integration - Composite Plates. Moments of Inertia - Determination of the Second Moment or Moment of Inertia of an Area by Integration - Moments of Inertia of Composite Areas - Polar Moment of Inertia - Radius of Gyration - Product of Inertia - Parallel-Axis Theorem - Principal Axes and Principal Moments of Inertia - Suggested Reading: Theorems of Pappus-Guldinus - Center of Gravity of a Volume and Composite Bodies - Moment of Inertia of a Mass - Moments of Inertia of Composite Bodies.													CO-3 BTL-3	
Module 4 – Analysis of Structures													(6L+3T+6P)	
Trusses - Definition of a Truss - Simple Trusses - Analysis of Trusses by the Method of Joints - Analysis of Trusses by the Method of Sections. Frames - Structures Containing Multi-Force Members - Analysis of a Frame. Suggested Reading: Space Trusses and Machines													CO-4 BTL-3	
Module 5 – Dynamics of Particles													(6L+3T+6P)	
Kinetics of Particles - Rectilinear Motion of Particles - Position, Velocity, and Acceleration - Determination of the Motion of a Particle - Uniform Rectilinear Motion - Uniformly Accelerated Rectilinear Motion - Motion of Several Particles. Kinetics of Particles - Newton’s Second Law - Linear Momentum of a Particle - Rate of Change of Linear Momentum - Dynamic Equilibrium - Principle of Work and Energy - Work of a Force - Power and Efficiency - Potential Energy - Conservation of Energy - Principle of Impulse and Momentum - Impulsive Motion – Impact - Direct Central Impact - Oblique Central Impact. Suggested Reading: Curvilinear Motion of Particles - Rectangular Components of Velocity and Acceleration - Tangential and Normal Components - Radial and Transverse Components.													CO-5 BTL-4	
TEXT BOOKS														

1.	Beer, F. P and Johnston Jr. E.R. (2019), Vector Mechanics for Engineers: Statics and Dynamics, Tata McGraw-Hill Publishing company, 12 th Edition.
2.	Meriam J.L. and Kraige L.G. (2018), Engineering Mechanics - Statics and Dynamics, John Wiley & Sons, 9th Edition, 448 pages.
REFERENCE BOOKS	
1.	Hibbeler, R.C and Ashok Gupta (2017), Engineering Mechanics: Statics and Dynamics, Pearson Education, 14th Edition.
2.	Timoshenko S. & Young D. H. (2017), Engineering Mechanics, Mc-GrawHill Education, 5th Edition.
E BOOKS	
1.	https://drive.google.com/open?id=0B9bpsTYXP4ceTnBneXhzRV96dWVs
2.	https://drive.google.com/open?id=0B9bpsTYXP4ceSUZLaEYyNDRGMWs
3.	https://drive.google.com/open?id=0B9bpsTYXP4ceRjBJQjd1UTVmNHM
MOOC	
1.	https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/
2.	http://www.nptel.ac.in/courses/112103109/
3.	http://www.nptelvideos.in/2012/11/engineering-mechanics.html

COURSE TITLE	OUTREACH (NCC)- LEVEL II (ARMY WING)			CREDITS	1
COURSE CODE	GGE51403	COURSE CATEGORY	HS	L-T-P-S	0-0-2-4
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	PRACTICAL
15%	15%	10%	5%	5%	50%
Course Description	The NCC provides exposure to the cadets in a wide range of activities., with a distinct emphasis on Social Services, Discipline and Adventure Training.				
Course Objective	The training curriculum of the NCC is primarily focused on character building, inculcating leadership qualities and skill enhancement through structured academic syllabi, practical training and opportunity for exposure/interaction beyond a cadets' immediate environment, and thereby enabling them for a brighter and progressive future.				

Course Outcome		1. To develop character, comradeship, discipline, secular outlook, spirit of adventure and the ideals of selfless service amongst the youth of the country. 2. To create a human resource of organized, trained and motivated youth to provide leadership in all walks of life and always available for the service of the nation. 3. To provide a suitable environment to motivate the youth to take up a career in the Armed Forces.												
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	1	1	-	2	1	3	2	3	3	2	-	-
CO-2	1	2	1	1	-	2	1	3	2	3	3	2	-	-
CO-3	1	2	1	1	-	2	1	3	2	3	3	2	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: NCC GENERAL													(6P)	
NCC GENERAL: NCC 1 Aims, Objectives & Organization of NCC 1 NCC 2 Incentives 2 NCC 3 Duties of NCC Cadet 1 NCC 4 NCC Camps: Types & Conduct 2												CO-1 BTL-3		
MODULE 2: NATIONAL INTEGRATION AND AWARENESS													(6P)	
NATIONAL INTEGRATION AND AWARENESS 4 NI 1 National Integration: Importance & Necessity 1 NI 2 Factors Affecting National Integration 1 NI 3 Unity in Diversity & Role of NCC in Nation Building 1 NI 4 Threats to National Security 1												CO-2 BTL-3		
MODULE 3: PERSONALITY DEVELOPMENT.													(6P)	
PERSONALITY DEVELOPMENT 7 PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving 2 PD 2 Communication Skills 3 PD 3 Group Discussion: Stress & Emotions 2												CO-3 BTL-3		
MODULE 4: LEADERSHIP													(6P)	
LEADERSHIP 5 L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour ' Code 3 L 2 Case Studies: Shivaji, Jhansi Ki Rani 2												CO-4 BTL-3		
MODULE 5: SOCIAL SERVICE AND COMMUNITY DEVELOPMENT													(6P)	
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT 8 SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth 3 SS 4 Protection of Children and Women Safety 1 SS 5 Road / Rail Travel Safety 1 SS 6 New Initiatives 2 SS 7 Cyber and Mobile Security Awareness 1												CO-5 BTL-3		
TEXT BOOKS														

<u>1.</u>	<u>NCC COMMON SUBJECT BOOK</u>
<u>2.</u>	<u>RED BOOK (ARMY SPECIAL SUBJECTS)</u>

COURSE TITLE		OUTREACH (NCC)- LEVEL II (AIR WING)						CREDITS			1				
COURSE CODE		GGE51403		COURSE CATEGORY		HS		L-T-P-S			0-0-2-4				
Version		1.0		Approval Details		36 th ACM		LEARNING LEVEL			BTL-3				
ASSESSMENT SCHEME															
CIA													ESE		
First Periodical Assessment (Theory)		Second Periodical Assessment (Theory)		Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”			Attendance		PRACTICAL				
15%		15%		10%		5%			5%		50%				
Course Description		The NCC provides exposure to the cadets in a wide range of activities., with a distinct emphasis on Social Services, Discipline and Adventure Training.													
Course Objective		The training curriculum of the NCC is primarily focused on character building, inculcating leadership qualities and skill enhancement through structured academic syllabi, practical training and opportunity for exposure/interaction beyond a cadets’ immediate environment, and thereby enabling them for a brighter and progressive future.													
Course Outcome		1. To develop character, comradeship, discipline, secular outlook, spirit of adventure and the ideals of selfless service amongst the youth of the country. 2. To create a human resource of organized, trained and motivated youth to provide leadership in all walks of life and always available for the service of the nation. 3. To provide a suitable environment to motivate the youth to take up a career in the Armed Forces.													
CO, PO AND PSO MAPPING															
CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	
CO-1	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-2	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-3	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: NCC GENERAL (6P)															

NCC GENERAL: NCC 1 Aims, Objectives & Organization of NCC 1 NCC 2 Incentives 2 NCC 3 Duties of NCC Cadet 1 NCC 4 NCC Camps: Types & Conduct 2	CO-1 BTL-3
MODULE 2: NATIONAL INTEGRATION AND AWARENESS (6P)	
NATIONAL INTEGRATION AND AWARENESS 4 NI 1 National Integration: Importance & Necessity 1 NI 2 Factors Affecting National Integration 1 NI 3 Unity in Diversity & Role of NCC in Nation Building 1 NI 4 Threats to National Security 1	CO-2 BTL-3
MODULE 3: PERSONALITY DEVELOPMENT. (6P)	
PERSONALITY DEVELOPMENT 7 PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving 2 PD 2 Communication Skills 3 PD 3 Group Discussion: Stress & Emotions 2	CO-3 BTL-3
MODULE 4: LEADERSHIP (6P)	
LEADERSHIP 5 L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour ' Code 3 L 2 Case Studies: Shivaji, Jhansi Ki Rani 2	CO-4 BTL-3
MODULE 5: SOCIAL SERVICE AND COMMUNITY DEVELOPMENT (6P)	
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT 8 SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth 3 SS 4 Protection of Children and Women Safety 1 SS 5 Road / Rail Travel Safety 1 SS 6 New Initiatives 2 SS 7 Cyber and Mobile Security Awareness 1	CO-5 BTL-3
TEXT BOOKS	
NCC COMMON SUBJECT BOOK	
RED BOOK (ARMY SPECIAL SUBJECTS)	

COURSE TITLE	OUTREACH (NCC)- LEVEL II (NAVY WING)			CREDITS	1
COURSE CODE	GGE51403	COURSE CATEGORY	HS	L-T-P-S	0-0-2-4
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	PRACTICAL

15%	15%	10%	5%	5%	50%										
Course Description	The NCC provides exposure to the cadets in a wide range of activities., with a distinct emphasis on Social Services, Discipline and Adventure Training.														
Course Objective	The training curriculum of the NCC is primarily focused on character building, inculcating leadership qualities and skill enhancement through structured academic syllabi, practical training and opportunity for exposure/interaction beyond a cadets’ immediate environment, and thereby enabling them for a brighter and progressive future.														
Course Outcome	1. To develop character, comradeship, discipline, secular outlook, spirit of adventure and the ideals of selfless service amongst the youth of the country. 2. To create a human resource of organized, trained and motivated youth to provide leadership in all walks of life and always available for the service of the nation. 3. To provide a suitable environment to motivate the youth to take up a career in the Armed Forces.														
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	
CO-1	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-2	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-3	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: NCC GENERAL (6P)															
NCC GENERAL: NCC 1 Aims, Objectives & Organization of NCC 1 NCC 2 Incentives 2 NCC 3 Duties of NCC Cadet 1 NCC 4 NCC Camps: Types & Conduct 2													CO-1 BTL-3		
MODULE 2: NATIONAL INTEGRATION AND AWARENESS (6P)															
NATIONAL INTEGRATION AND AWARENESS 4 NI 1 National Integration: Importance & Necessity 1 NI 2 Factors Affecting National Integration 1 NI 3 Unity in Diversity & Role of NCC in Nation Building 1 NI 4 Threats to National Security 1													CO-2 BTL-3		
MODULE 3: PERSONALITY DEVELOPMENT. (6P)															
PERSONALITY DEVELOPMENT 7 PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving 2 PD 2 Communication Skills 3 PD 3 Group Discussion: Stress & Emotions 2													CO-3 BTL-3		
MODULE 4: LEADERSHIP (6P)															
LEADERSHIP 5 L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour ‘ Code 3 L 2 Case Studies: Shivaji, Jhansi Ki Rani 2													CO-4 BTL-3		
MODULE 5: SOCIAL SERVICE AND COMMUNITY DEVELOPMENT (6P)															

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT 8 SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth 3 SS 4 Protection of Children and Women Safety 1 SS 5 Road / Rail Travel Safety 1 SS 6 New Initiatives 2 SS 7 Cyber and Mobile Security Awareness 1	CO-5 BTL-3
<u>TEXT BOOKS</u>	
<u>NCC COMMON SUBJECT BOOK</u>	
<u>RED BOOK (ARMY SPECIAL SUBJECTS)</u>	

COURSE TITLE	OUTREACH (NSS,Y's Men, Rotract)- LEVEL II			CREDITS	1
COURSE CODE	GGE51404	COURSE CATEGORY	HS	L-T-P-S	0-0-2-4
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	-
ASSESSMENT SCHEME					
CIA					ESE
Volunteering	Events attended	Awareness Programs attended		Attendance	Report Submission
5	25	15		5%	50
Course Description	This course is designed to introduce students to the principles and practices of community service, social development, and active citizenship. The course aims to instill a sense of social responsibility and promote civic engagement among the participants. Through a combination of theoretical knowledge and practical experiences, students will develop essential skills and qualities required to make a positive impact on the community and society. Pre requisite: There are no specific prerequisites for enrolling in the NSS Semester 1 course. However, a genuine interest in community service, social development, and willingness to actively engage with diverse communities are essential.				
Course Objective	1. To familiarize students with the objectives, history, and importance of the National Service Scheme (NSS) in community development, emphasizing the significance of social responsibility and civic engagement. 2. To develop essential leadership skills, teamwork, and effective project management techniques, preparing students to organize and execute community service projects successfully. 3. To cultivate empathy, compassion, and cultural sensitivity, enabling students to engage respectfully and effectively with diverse communities during their community service activities. 4. To promote environmental awareness and sustainable practices, encouraging students to integrate eco-friendly approaches into their community service initiatives. 5. To enhance students' communication, problem-solving, and decision-making skills, equipping them to engage with community members, stakeholders, and address challenges effectively.				

Course Outcome	1. students will gain a comprehensive understanding of the objectives, history, and significance of the National Service Scheme (NSS) in promoting community development and social responsibility.														
	2. Participants will demonstrate the ability to identify and assess prevalent social issues and challenges in the community, laying the groundwork for effective community service initiatives.														
	3. Through practical experiences and workshops, students will develop essential leadership skills, teamwork, and project management techniques necessary for organizing and executing successful community service projects.														
	4. By engaging with diverse communities, students will cultivate empathy, compassion, and cultural sensitivity, fostering meaningful and respectful interactions during their service activities.														
	5. Upon completion of Semester 1, students will have improved their communication, problem-solving, and decision-making skills, empowering them to actively and effectively engage in community development and service projects.														
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	
CO-1	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-2	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-3	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-4	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
CO-5	1	2	1	1	-	2	1	3	2	3	3	2	-	-	
1: Weakly related, 2: Moderately related and 3: Strongly related															
TOPICS TO BE COVERED															
1. Introduction to National Service Scheme (NSS) and its Objectives 2. Understanding Social Issues and Needs Assessment in the Community 3. Project Planning and Management for Community Service 4. Leadership Development and Teamwork 5. Cultural Sensitivity and Interacting with Diverse Communities 6. Communication and Problem-Solving Skills for Community Engagement 7. Environmental Conservation and Sustainable Practices 8. Health, Hygiene, and Community Well-being 9. The Role of Arts and Culture in Community Development 10. Reflecting on Community Service Experiences and Personal Growth														(30P)	
Suggest Activities															
1. Community Cleanliness Drive: Organize a cleanliness drive in the local community, involving students and residents in cleaning public spaces and creating awareness about cleanliness and waste management. 2. Health Awareness Camp: Conduct a health awareness camp where participants can provide basic health check-ups, distribute health-related information, and promote the importance of hygiene and sanitation. 3. Environmental Conservation Project: Initiate an environmental conservation project, such as tree planting, creating green spaces, or implementing recycling programs, to raise awareness about environmental issues.															

4. Teaching Assistance in Local Schools: Collaborate with local schools to provide teaching assistance, conduct educational workshops, and help students with their studies. 5. Empowerment Workshops: Organize workshops for women, youth, or other marginalized groups to empower them with skills and knowledge relevant to their needs, such as vocational training or financial literacy. 6. Cultural Exchange Program: Arrange a cultural exchange event where NSS participants and local community members can share their traditions, dances, music, and food, fostering mutual understanding and appreciation. 7. Blood Donation Camp: Partner with local healthcare institutions to organize a blood donation camp to address blood shortages and raise awareness about the importance of donating blood. 8. Community Survey and Needs Assessment: Conduct a comprehensive community survey to understand the needs and priorities of the local residents, guiding the selection of future service projects. 9. Awareness Campaigns: Create awareness campaigns on critical social issues like gender equality, education, or substance abuse through street plays, posters, and interactive sessions. 10. Disaster Preparedness Workshop: Conduct workshops on disaster preparedness, including first aid training and emergency response, to equip the community with necessary skills. 11. Senior Citizens' Engagement: Plan activities and events to engage and support senior citizens, such as organizing social gatherings or providing assistance with daily chores. 12. Digital Literacy Initiatives: Set up digital literacy workshops to help community members, especially elders and underserved individuals, to learn basic computer and internet skills. 13. Community Sports Event: Organize a community sports event to promote fitness, teamwork, and community bonding. 14. Skill Development Sessions: Arrange skill development workshops in collaboration with local experts to teach practical skills like tailoring, painting, or handicrafts. 15. Awareness on Government Schemes: Educate the community about various government schemes and programs that they may be eligible for, to ensure they can avail themselves of the benefits.		
REFERENCE BOOKS		
1	National Service Scheme Manual, Government of India.	
2	Orientation Courses for N.S.S. Programme officers, TISS.	
3	Case material as Training Aid for field workers, Gurmeet Hans.	
4	National Service Scheme Manual, Government of India.	
5	Training Programme on National Programme scheme, TISS.	
6	Social Problems in India, Ram Ahuja	
7	Social service opportunities in Hospitals, Kapil K. Krishan, TISS.	

Semester-III

COURSE TITLE	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS			CREDITS	4
COURSE CODE	EMA51003	COURSE CATEGORY	BS	L-T-P-S	3-1-0-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					

CIA													ESE		
First Periodical Assessment	Second Periodical Assessment			Seminar/ Assignments/ Project			Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”			Attendance			End Semester Examination		
15%	15%			10%			5%			5%			50%		
Course Description	To make the student understand the basic concepts of partial differential equations and transforms and its applications														
Course Objective	1. To present the main results in the context of partial differential equations and to study numerical methods for the approximation of their solution 2. To introduce the wave equation including time and position dependence 3. To comprehend the mechanisms of heat transfer under steady and transient conditions. 4. To enable the students to study the concept of Fourier Transform 5. To convert a discrete-time system into the difference equation using the Z Transform.														
Course Outcome	Upon completion of this course, the students will be able to 1. Formulate and solve standard types of partial differential equations. 2. Solve the Wave and Heat equations. 3. Obtain the solution of two dimensional heat equations. 4. Apply Fourier transform to find the definite integrals. 5. Compute the solution of the difference equation using Z-Transform.														
Prerequisites: Basics in Differential Equations.															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	
CO-1	3	3	2	2	2	3	1	-	1	1	-	-	1	2	
CO-2	3	3	2	2	2	1	-	-	1	1	-	-	2	1	
CO-3	3	3	2	2	2	1	-	-	1	1	-	-	1	1	
CO-4	3	3	2	2	2	1	-	-	1	1	-	-	2	2	
CO-5	3	3	2	2	2	1	-	-	1	1	-	-	1	2	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PARTIAL DIFFERENTIAL EQUATIONS													(9L+3T)		

Formation of partial differential equations by elimination of arbitrary constants, arbitrary functions - Solution of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients. Suggested Reading: Partial Differentiation		CO-1 BTL-3
MODULE 2: ONE DIMENSIONAL WAVE AND HEAT FLOW EQUATION		(9L+3T)
Classification of second order linear partial differential equations - Solutions of one dimensional wave equation (without proof) - One dimensional heat flow equation (without proof) and application in string and rod problems. Suggested Reading: Partial Differential Equations, Half range sine series.		CO-2 BTL-3
MODULE 3: TWO DIMENSIONAL HEAT FLOW EQUATION		(9L+3T)
Steady state solution of two dimensional heat equations and applications in finite plates and infinite plates problems. Suggested Reading: Partial Differential Equations, Half range sine series.		CO-3 BTL-3
MODULE 4: FOURIER TRANSFORM		(9L+3T)
Fourier Integral Theorem (without proof) - Fourier transform pair - Sine and Cosine transforms - Properties - Transforms of Simple functions - Convolution theorem - Parseval's identity. Suggested Reading: Basic integration .		CO-4 BTL-3
MODULE 5: Z-TRANSFORM AND DIFFERENCE EQUATIONS		(9L+3T)
Z-Transform - Elementary Properties - Inverse Z-Transform - Convolution theorem - Formation of Difference equations - Solution of difference equations using Z-Transform Suggested Reading: Basic calculus.		CO-5 BTL-3
TEXT BOOKS		
1.	P. Sivarama Krishna Das and C. Vijayakumar. L (2017) Transforms and partial differential equations, 1 Pearson Publication.	
2.	Grewal. B.S (2012) Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, Delhi, 2012	
3.	Chandrasekaran A (2015) A Text Book of Transforms and Partial Differential Equations, Dhanam Publication.	
REFERENCE BOOKS		
1.	BalLN.P and Manish Goyal (2007) A Textbook of Engineering Mathematics, 7th Edition, Laxmi Publications Pvt Ltd.	
2.	Datta.K.B (2013) Mathematical Methods of Science and Engineering, Cengage Learning India Pvt Ltd, Delhi.	
3.	Veerarajan. T (2012) Transforms and Partial Differential Equation", Tata McGraw Hill Education Pvt. Ltd., Second reprint , New Delhi.	
E BOOKS		

1.	https://link.springer.com/book/10.1007/978-1-4614-4809-9
2.	https://s2pnd-matematika.fkip.unpatti.ac.id/wp-content/uploads/2019/03/Walter-A-Strauss-Partial-differential-equations-_an-introduction-Wiley-2009.pdf
MOOC	
1.	nptel.ac.in/courses/122107037/

COURSE TITLE		PUBLIC SPEAKING AND GROUP DISCUSSION			CREDITS	1	
COURSE CODE		GLS51400	COURSE CATEGORY		HS	L - T - P - S	0-0-3-1
Version	01	Approval Details		42 nd ACM, 26 th Oct. 2024		LEARNING LEVEL	BTL -4
ASSESSMENT SCHEME							
CIA							ESE
First Periodical Assessment	Second Periodical Assessment	Practical Assessments as approved by the Department Examination Committee “DEC”		Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance	Practical
15 %	15 %	10 %		5 %		5 %	50 %
Course Description		This course is an introduction to speech communication leading to group discussion that emphasizes the practical skill of public speaking, including techniques to lessen speaker anxiety and the use of visual aids to enhance speaker presentations. Civility and ethical speech-making are the foundations of this course. Its goal is to prepare students for success in typical public speaking situations and to provide them with the basic principles of organization and research needed for effective speeches. Students will learn effective self-presentation techniques, encompassing body language, attire, and verbal communication. Through practical exercises and mock sessions, students will gain hands-on experience and receive constructive feedback.					
Course Objective		By the end of this course, students will be able to: 1. Develop the ability to critically evaluate speeches by assessing both verbal and non verbal elements to effectively analyse their overall effectiveness. 2. Enhance audience analysis skills to understand the preferences, needs, and characteristics of the target audience and design speeches and discussions that align with their expectations and interests. 3. Acquire the capability to organise content in a manner that achieves specific objectives, such as providing information, persuasive arguments, or fulfilling the unique requirements of special occasions. 4. Develop skills through research and preparation of discussion topics, understanding group dynamics, building consensus and negotiation through effective verbal and non verbal responses. 5. Develop proficient research skills by critically analysing and interpreting diverse and relevant sources of information on a wide range of topics to bolster the credibility and depth of the speeches and group discussions.					
Course		Upon completion of this course, the students will be able to					

Outcome	1. Evaluate speeches based on a variety of verbal and non-verbal criteria. 2. Analyse the audience and design speeches to reflect the analysis. 3.Show increased confidence in their ability to handle interview and group discussion scenarios, reducing anxiety and stress. 4.Assess insightful questions that reflect their understanding and interest in the role or discussion topic. 5.Analyse meaningful research on a variety of topics.													
Prerequisites: Plus Two English-Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	2	1	0
CO2	-	-	-	-	-	-	-	-	-	3	-	2	1	1
CO3	-	-	-	-	-	-	-	-	2	3	-	2	0	1
CO4	-	-	-	-	-	-	-	-	2	3	-	2	1	0
CO5	-	-	-	-	-	-	-	-	2	3	-	2	1	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 :Effectiveness of the Communication														(9P)
Introduction to the Art of Speaking – Having simple great communication and removing the complexities —Rate of Speech to be heard-Usage of volume to add credibility & confidence-Tonality-to add emotion to your voice Speaking Skills (Activities): Self-Introduction-Speak for 60 seconds & Real life situations													CO-1 BTL-2	
MODULE 2 : Designing and Enhancing Public Speaking Skills														(9P)
Public Speaking and Audience Analysis- Acquire knowledge – Skill in real life presentation – Techniques for Conducting Audience Analysis– Adapting Speech Content- Visual aids – Organising Speeches for Information, Persuasion, and Special Occasions- Art of speech – Organisational Structures for Informative Speeches– Adapting Speech Organization to Special Occasions – Introduction and basic skills of an Emcee- -Dealing with -Nervousness-Audience-- Content-Fear- Feedback-Personality Humour-Use of Voice & Hands -To have self-confidence – Anecdotes – Personal Experiences – knowledge on current events Speaking Skills (Activities): Team Presentation-Role Plays - Monologues- Recitations. Group Debates - Impromptu Speaking													CO-2 BTL-3	
MODULE 3 :Speaker’s Tool Kit														(9P)
Brilliant ways to start any presentation -Designing- Making it Real Importance of Planning Importance of Structuring-Refining & Sketching the Draft-How to put together a great Presentation Preparation – Purpose of the Speech - Selecting the subject –Making an outline – Research Analysis Methods for Informative Speeches -Gathering materials – Critical Thinking and Research Ethics– Time Management – Rehearsing Speaking Skills (Activities): On the spot topic speech for 5 minutes-Mock Interviews – Panel sessions													CO-3 BTL-3	

MODULE 4 : Principles and its applications for GD		(9P)
Group Discussion Fundamentals: Purpose and Format of Group Discussions- Techniques to Generate Ideas- Roles in a Group Discussion-Evaluating Group Performance - Effective Participation in Group Discussions: Initiating the Discussion-Building on Others' Ideas-Disagreeing Respectfully-Summarising Points. - Understanding Group Dynamics: Types of Group Members-Leadership in Group Discussions-Managing Dominant Participants- Encouraging Quiet Participants Speaking Skills (Activities): Fostering Active Engagement through Fishbowl Discussion		CO-4 BTL-3
MODULE 5 : Navigating through Group Discussion		(9P)
Mock Group Discussions: Simulated Group -Discussions-Peer Feedback Sessions-Instructor Feedback- Reflection and Improvement. Time Management in Interviews and Discussions: Structuring- Responses-Managing - Discussion Time-Prioritising Key Points-Avoiding Rambling - Speaking Skills (Activities): Conducting mock PI and GD sessions and providing constructive feedback.		CO-5 BTL-4
TEXT BOOKS		
1	Carnegie, Dale and Esenwein, J. Berg. (2018) <i>The Art Of Public Speaking</i> . Rupa Publications India,	
REFERENCE BOOKS		
1.	Peale, Norman Vincent.(2017) <i>The Power of Positive Thinking</i> , Fingerprint Publishing.	
2.	Carnegie, Dale (2015). <i>The Art of Public Speaking</i> , Mittal Books Publishing House.	
3	The Ted Talks:The official Ted Guide To Public Speaking Paperback-2018	
4.	Shankar, G. (2019). GD Guide: To Excel in Group Discussion. Independently Published.	
5.	S. Hundiwala. (2019). A Complete Kit for Group Discussion. Arihant Publications India Limited.	
E Books		
1.	https://www.managementhelp.org/public-speaking	
2.	https://gtu.ge/Agro-Lib/successful-public-speaking.pdf	
3.	(Mock Group Discussion(GD) 1 IIM Interview Questions and Answers. YouTube) Mock Group Discussion(GD) 1 IIM Interview Questions and Answers	
4.	(Group Discussion "Will Artificial Intelligence take away jobs?" YouTube) Group Discussion "Will Artificial Intelligence take away jobs?"	
MOOC Courses		
1	https://www.coursera.org/learn/public-speaking	
2	https://onlinecourses.nptel.ac.in/noc22_hs134/preview	

COURSE TITLE	THERMODYNAMICS AND HEAT TRANSFER								CREDITS		4			
COURSE CODE	EAT51002			COURSE CATEGORY			PC		L-T-P-S		2-1-2-2			
VERSION	1.0			APPROVAL DETAILS			36 TH ACM		LEARNING LEVEL		BTL-3			
ASSESSMENT SCHEME														
CIA										ESE				
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)			Practical Assessments			Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		Theory		Practical	
15%	15%			10%			5%		5%		25 %		25%	
Course Description	This course Thermodynamics deals with the heat, work and energy of a system. It also deals with the concepts and application of thermodynamics related to various laws which includes first and second law of thermodynamics. This course also deals the applications in Engineering point of view. More over the course provides a detail discussion on Rankine cycle, Air compressors, Refrigeration and the concepts of heat transfer.													
Course Objectives	1. To apply the concepts of first and second law of thermodynamics. 2. To analyze the second law of thermodynamics with respect engineering components 3. To identify and describe the vapour power cycles 4. To analyze the performance of reciprocating air compressors and refrigeration. 5. To apply the concepts of Heat Transfer													
Course Outcomes	Upon completion of this course, the students will be able to 1. Apply the concept of first and second law of thermodynamics. 2. Analyze the second law of thermodynamics 3. Identify and describe the vapour power cycles 4. Analyze the performance of reciprocating air compressors and refrigeration. 5. Apply the concepts of Heat Transfer													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO-1	3	3	3	3	3	1	1	-	1	-	1	1	2	2
CO-2	3	3	3	3	3	1	1	-	1	-	1	1	2	2
CO-3	3	3	3	3	3	1	1	-	1	-	1	1	2	2
CO-4	3	3	3	3	3	1	1	-	1	-	1	1	2	2
CO-5	3	3	3	3	3	1	1	-	1	-	1	1	2	2
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														

Module 1 – Basic Concepts and FIRST LAW OF THERMODYNAMICS	(6L+3T+6P)
Thermodynamic System, thermodynamic equilibrium, state, property, process, cycle, Zeroth law of thermodynamics, energy, work, heat, first law of thermodynamics, application of first law of thermodynamics to closed and open systems, steady flow process, Engineering application of steady flow energy equation. Practical Component: Solution of SFEE for various applications in MATLAB. Equipment /Software : MATLAB	CO-1 BTL-3
Module 2 – SECOND LAW OF THERMODYNAMICS	(6L+3T+6P)
Limitations of first law, statements of second law of thermodynamics, Clausius inequality, heat engine, heat pump, refrigerator, Carnot cycle, Carnot theorem, entropy, temperature - Entropy diagram, entropy changes for a closed system. Third Law of Thermodynamics. Practical Component: Performance test on an Internal Combustion Engine Equipment/Software : I C Engine Test Rig	CO-2 BTL-3
Module 3 – VAPOUR POWER CYCLE	(6L+3T+6P)
Formation of steam and its thermodynamic properties, Dryness fraction, Quality of steam-by-steam tables and Mollier chart – Rankine cycle, Reheat Cycle- Regenerative cycle - Work done.	CO-3 BTL-3
Module 4 – RECIPROCATING AIR COMPRESSORS, REFRIGERATION CYCLES	(6L+3T+6P)
Single acting and double acting air compressors, work required effect of clearance volume, volumetric efficiency, isothermal efficiency, multistage compression, condition for minimum work. Fundamentals of refrigeration, C.O.P, simple vapour compression refrigeration system, simple vapour absorption refrigeration system, (Descriptive only), Refrigerants Practical Component Study of Refrigeration and air conditioning systems Equipment /Software 1. Refrigeration set up 2. Air conditioning set up	CO-4 BTL-3
Module 5 – Heat Transfer	(6L+3T+6P)
Modes of heat transfer, Fourier's law of conduction, one dimensional steady state conduction through plane and composite walls, cylinders. Free and forced convection, dimensionless numbers, thermal boundary layer, heat transfer co-efficient, simple problems overall heat transfer coefficient, heat exchangers, LMTD, concept of radiation- Stefan Boltzmann law, Black body and Grey body radiation. Practical Component 1. To find the thermal conductivity for the given material 2. To find the heat transfer in Parallel flow and Counter flow exchangers. Equipment /Software 1. Thermal Conductivity apparatus 2. Pipe Flow heat exchanger apparatus	CO-5 BTL-3
TEXT BOOKS	

1.	Moran, Michael J., Howard N. Shapiro, Daisie D. Boettner, and Margaret B. Bailey. Fundamentals of engineering thermodynamics. John Wiley & Sons, 2018.
2.	Nag, P. K. "Engineering thermodynamics." New Delhi (2017).
REFERENCE BOOKS	
1.	Cengel, Yunus A., Michael A. Boles, and Mehmet Kanoğlu. Thermodynamics: an engineering approach. Vol. 5. New York: McGraw-hill, 2011.
2.	Rao, Y. V. C. An introduction to thermodynamics. Universities Press, 2004.
E BOOKS	
1.	https://www.mheducation.co.in/engineering-thermodynamics-9789352606429-india
2.	https://www.laxmipublications.com/servlet/lpgetbiblio?bno=000172&pageName=Author
MOOC	
1.	https://nptel.ac.in/courses/127106135
2.	https://www.edx.org/course/thermodynamics
3.	https://www.coursera.org/learn/thermodynamics-intro

COURSE TITLE	AUTOMOTIVE ENGINE TECHNOLOGY			CREDITS	3	
COURSE CODE	EAT51003	COURSE CATEGORY	PC	L-T-P-S	2-0-2-2	
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-4	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25 %	25%
Course Description	The course provides an overall insight about construction, working of SI and CI Engines. Also provide in-depth analyses of combustion of SI and CI Engines. Testing Methods of Fuels and Engines along with its significances will be educated to the learners. Finally, course also provide detailed insights about advance technologies in the domain of IC Engines and Fuels.					
Course Objectives	1. Students should explain the constructions and working principles of automotive engines 2. Students should analyze the significance of SI Engine Combustion 3. Students should analyze the significance of CI Engine Combustion 4. Students should evaluate the fuel and engine testing procedures 5. Students should elucidate the advance engine and combustion technologies					

Course Outcomes	Upon completion of this course, the students will be able to													
	1. Explain the constructions and working principles of automotive engines													
	2. Analyze the significance of SI Engine Combustion													
	3. Analyze the significance of CI Engine Combustion													
	4. Evaluate the fuel and engine testing procedures													
	5. Elucidate the advance engine and combustion technologies													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO-1	3	2	2	2	2	2	2	1	2	1	1	3	3	3
CO-2	3	2	2	2	2	2	2	1	2	1	1	3	3	3
CO-3	3	2	2	2	2	2	2	1	2	1	1	3	3	3
CO-4	3	2	2	2	3	3	3	1	2	1	1	3	3	3
CO-5	3	2	2	2	3	3	3	1	2	1	1	3	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction to IC Engines													(6L+6P)	
History-Construction and Working of IC Engines-Combustion-Cycle-Engine Efficiency -Torque and Power Output -Valve and Port Timing -Air Fuel Ratio Lab Component: Introduction to Engine Components - Valve and Port Timing Diagram, TDC Marking													CO-1 BTL-4	
Module 2 – Spark Ignition Engine													(6L+6P)	
Introduction - Air Fuel Induction System - Ignition System - Stages of Combustion in SI Engine - Knocking Combustion - Design of Combustion Chamber - Cooling and Lubrication System - OBD Tools Lab Component: Performance Test on Single Cylinder SI Engine - More Test on Single Cylinder SI Engine													CO-2 BTL-4	
Module 3 – Compression Ignition Engine													(6L+6P)	
Introduction - Air & Fuel Induction System - Injection System –Common rail injection system - Stages of Combustion in CI Engine - Knocking Combustion - Design of Combustion Chamber - Cooling and Lubrication System - OBD Tools Lab Component: Performance Test on Single Cylinder CI Engine - Performance Test on Multi Cylinder CI Engine													CO-3 BTL-4	
Module 4 – Fuels and Engine Testing													(6L+6P)	
Fuel Properties - Characterization – Engine Testing Procedure - Performance Parameters - Emission Parameters Combustion Parameters Lab Component: Viscosity Measurement - Heating Value Measurement - Fuel Characterization Study-Emission Measurements - Combustion Testing													CO-4 BTL-4	
Module 5 – Advanced Engine Technology													(6L+6P)	
GDI Engines – HCCI Engines - Low Temperature Combustion Concepts - Control Strategies - Multi Fuel Engines - Low Carbon Fuels and Regulation - Engine and Fuel Modification													CO-5 BTL-4	

Lab Component:		
Heat Balance Sheet Calculation - Testing of Dual Fuel Engines		
TEXT BOOKS		
1.	Ganesan V, "Internal Combustion Engines", Tata McGraw-Hill, 2003.	
2.	Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989	
REFERENCE BOOKS		
1.	Internal Combustion Engine Handbook, 2 nd English Edition, Richard Van Basshuysen, Fred Schaefer SAE International ISBN of 978-0-7680-8024-7	
2.	Bosch Automotive Handbook, 10 th Edition Robert Bosch ISBN of 978-0-7680-9567-8	
3.	Mathur M. L and Sharma. R. P, "A Course in Internal Combustion Engines", Dharpai Rai & Sons, 1993.	
4.	Pundir B. P., "IC Engines Combustion and Emissions", Narosa Publishing House, 2010.	
E BOOKS		
1.	https://myxfpzg.files.wordpress.com/2015/08/robert-bosch-automotive-electronics-handbook-pdf.pdf	
2.	http://opac.vimaru.edu.vn/edata/EBook/NH2014/CSDL_CS2014_2/HH0074.pdf	
MOOC		
1.	https://nptel.ac.in/courses/112104033	
2.	https://nptel.ac.in/courses/112103262	

COURSE TITLE	MATERIALS AND MANUFACTURING PROCESS OF AUTOMOTIVE COMPONENTS				CREDITS	3
COURSE CODE	EAT51004	COURSE CATEGORY	PC		L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	This course gives knowledge on materials , manufacturing process of automotive components.					
Course Objectives	1. To familiarize on the constitutions of alloys, phase diagrams and various heat treatment process 2. To gain knowledge on the selection criteria of materials and properties of nonmetallic materials 3. To develop knowledge on the mechanical properties and testing of materials 4. To attain knowledge on casting & machining process of various automotive components 5. To develop knowledge on powder metallurgy technology					

Course Outcomes	Upon completion of this course, the students will be able to													
	1. Familiarize on the constitutions of alloys, phase diagrams and various heat treatment process													
	2. Gain knowledge on the selection criteria of materials and properties of nonmetallic materials													
	3. Develop knowledge on the mechanical properties and testing of materials													
	4. To obtain knowledge on casting & machining process of various automotive components													
	5. Attain knowledge on to familiarize on powder metallurgy technology													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	2	1	1	-	1	-	-	-	-	-	-	1	2	1
CO-2	1	2	1	-	-	-	-	-	-	2	-	2	1	1
CO-3	2	1	2	-	-	1	-	-	-	-	-	1	2	2
CO-4	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO-5	1	1	3	-	-	-	-	-	-	-	-	2	1	1
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
MODULE 1 – CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS													(6L+6P)	
Constitution of alloys - Solid solutions, substitutional and interstitial - phase diagrams, Isomorphous, eutectic, peritectic and eutectoid reactions, Iron - Iron carbide equilibrium diagram. Classification of steel and cast iron, properties and application. Heat Treatment- Annealing, Normalizing, hardening and tempering, Case hardening, carburising, nitriding, cyaniding, carbonitriding - Flame and Induction hardening. Experiment: Machining Operations in Lathe (Preparation of Steel Samples for Tensile Testing)													CO-1 BTL-3	
MODULE 2 - SELECTION OF MATERIALS													(6L+6P)	
Criteria of selecting materials for automotive components viz cylinder block, Cylinder head, piston, piston ring, connecting rod, crank shaft, crank case, cam, cam shaft, engine valve. NON-Metallic Materials- Properties and automotive applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS. Experiment: Different Heat Treatment Processes of Steel.													CO-2 BTL-3	
MODULE 3 – MECHANICAL PROPERTIES AND TESTING													(6L+6P)	
Mechanism of plastic deformation, slip and twinning - Types of fracture - Testing of materials under tension, compression and shear loads - Hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy, fatigue and creep test. Experiment: Microstructure Evaluation of Heat Treated and Untreated Steels													CO-3 BTL-3	
MODULE 4 – CASTING AND MACHINING													(6L+6P)	
Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, permanent mould casting of piston, pressure die casting of carburetor and other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins -piston rings - valves. Experiment: Evaluation of Tensile Strength of Heat Treated and Untreated Steels													CO-4 BTL-3	
MODULE 5 - POWDER METALLURGY													(6L+6P)	
Process flow chart - Production of metal powders and their raw materials - Manufacture of friction lining materials for clutches and brakes - Testing and inspection of PM parts. Experiment: Fabrication of Fiber Reinforced Polymeric Composites													CO-5 BTL-3	
TEXT BOOKS														

1.	Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" Prentice-Hall of India Private Limited, 4th Indian Reprint 2015.
2.	Heldt.P.M., High Speed Combustion Engines, Oxford publishing co., New York, 2010.
REFERENCE BOOKS	
1.	William D Callister "Material Science and Engineering", John Wiley and Sons 2012
2.	Raghavan.V.Materials Science and Engineering, Prentice Hall of India Pvt. Ltd., 2014
3.	Haslehurst.S.E., Manufacturing Technology, ELBS, London, 2010.
4.	Rusinoff., Forging and forming of metals, D.B, Taraporevla Son & co Pvt Ltd, Mumbai, 2005
E BOOKS	
1.	http://www.cognella.com/pdf/Mechanical-Testing-of-Engineering-Materials_sneak_preview.pdf
2.	http://weldguru.com/OLDSITE/mechanical-properties-of-metals.html#table
3.	http://ceb.ac.in/knowledge-center/E-BOOKS/The%20Automotive%20Development%20Process%20-%20Daniel%20Sorensen.pdf
4.	https://www.niir.org/books/book_pdf/101230/niir-complete-book-on-production-automobile-components-allied-products.pdf
MOOC	
1.	http://www.icterm.net/assets/Instron%20Materials%20Test%20Guide.pdf
2.	https://www.nde-ed.org/EducationResources/CommunityCollege/Materials/Mechanical/Mechanical.htm
3.	https://www.mooc-list.com/course/advanced-manufacturing-process-analysis-coursera
4.	https://www.mooc-list.com/course/advanced-manufacturing-enterprise-coursera

COURSE TITLE	ENVIRONMENTAL SCIENCE AND SUSTAINABLE DEVELOPMENT			CREDITS	2
COURSE CODE	GGE51003	COURSE CATEGORY	ES	L-T-P-S	2-0-0-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC"	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	To expose the students to the basics of environmental science and sustainable development.				

Course Objective	1. To make the students aware of the natural resources and to educate them to understand the need for preserving the resources. 2. To provide knowledge on the various aspects of environmental pollution and issues. 3. To provide basic knowledge and concepts of sustainability. 4. To educate the students about the concepts of sustainable habitat. 5. To give a broad knowledge on environmental management system.													
Course Outcome	Upon completion of this course, the students will be able to 1. Recognize the effects of over exploitation of natural resources and their impact on day-to-day life on earth. 2. Apply the sustainable solutions for environmental pollution and issues. 3. Implement the concepts of sustainability in the product development. 4. Use appropriate methods for designing green house and maintaining sustainable cities, transport system, industries, etc. 5. Manage the environment for sustainable product development.													
Prerequisites: Basic knowledge of science and environment.														
CO, PO AND PSO MAPPING														
CO	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	2	2	2	-	-	1	3	-	-	-	-	2	1	1
CO-2	2	2	2	-	-	1	3	-	-	-	-	2	2	2
CO-3	2	2	2	-	-	1	3	-	-	-	-	2	1	1
CO-4	2	2	2	-	-	1	3	-	-	-	-	2	1	1
CO-5	2	2	2	-	-	1	3	-	-	-	-	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: NATURAL RESOURCES													(6L)	
Introduction - Forest resources: Use and over-exploitation – Water resources: Use and over-utilization – Mineral resources: Use and exploitation – Food resources: World food problems, effects of modern agriculture – Energy resources: conventional and nonconventional, solar energy, fuel cells, wind energy, hydro plants, bio-fuels, Energy derived from oceans, geothermal energy – Land resources: Use and over-exploitation – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study – Documentation of nearby environmental assets – river / forest / grassland / hill / mountain.													CO-1 BTL-3	
MODULE 2: ENVIRONMENTAL POLLUTION AND ISSUES													(6L)	
Air pollution, effects of air pollutions; Water pollution – sources, sustainable waste water treatment; Solid waste – sources, impacts, zero waste concept, 3R concept, Global													CO-2	

environmental issues – Resource degradation, climate change, global warming, ozone layer depletion – Regional and local environmental issues – Carbon credits and carbon trading, carbon foot print.		BTL-3
Field Study - Observe a pond nearby and analyze the different measures that can be adopted for its conservation.		
MODULE 3: SUSTAINABILITY		(6L)
Introduction, need of sustainability – Social, environmental and economic sustainability concepts – sustainable development, Nexus between technology and sustainable development, challenges for sustainable development – multilateral environmental agreements and protocols – clean development mechanism (CDM) – Environmental legislations in India – water act, air act.		CO-3 BTL-3
Field Study - Assessment of sustainability in your neighborhood in education / housing / water resources / energy resources / food supplies/ land use / environmental protection, etc.		
MODULE 4: CONCEPTS OF SUSTAINABLE HABITAT		(6L)
Green buildings: material for sustainable design, green building certification, methods for increasing energy efficiency of buildings – sustainable urbanization - sustainable transport – Industrialization and poverty reduction – Industrial processes: material selection, pollution prevention, industrial ecology, industrial symbiosis.		CO-4 BTL-3
Assignment – Explore the different methods that can be adopted for maintaining a sustainable transport system in your city.		
MODULE 5: ENVIRONMENTAL MANAGEMENT		(6L)
Environmental management: Principles and strategies, Indicators of environmental quality – economic valuation - environmental cost-benefit analysis – Fiscal incentives in pollution control and management – Environmental management system: ISO 14000, Life Cycle Analysis (LCA) – scope and goal, bio-mimicking – Environmental Impact Assessment (EIA) – Procedures of EIA in India.		CO-5 BTL-3
Assignment – Conducting an EIA study of a small project (example, construction of house, road, bridge, etc.) in your local area.		
TEXT BOOKS		
1.	Basu, M., Savarimuthu, X. (2017). <i>Fundamentals of Environmental Studies</i> , Cambridge University Press, 1 st Edition.	
2.	Bhavik R. Bakshi (2019). <i>Sustainable Engineering: Principles and Practice</i> , Cambridge University Press, 1 st Edition.	
3.	Mulligan, C. (2020). <i>Sustainable Engineering: Principles and Implementation</i> , CRC Press, 1 st Edition.	
REFERENCE BOOKS		

1.	Wasewar, K. L., Rao, S. N. (2022). <i>Sustainable Engineering, Energy, and the Environment Challenges and Opportunities</i> , CRC Press, 1 st Edition.
2.	Singh, J.S., Singh, S.P., Gupta, S. R. (2017). <i>Ecology, Environmental Science and Conservation</i> . S. Chand Publishing Company, New Delhi,
E BOOKS	
1.	https://www.hzu.edu.in/bed/E%20V%20S.pdf
2.	https://library.oapen.org/handle/20.500.12657/33379
MOOC	
1.	https://www.my-mooc.com/en/categorie/environmental-science
2.	https://www.coursera.org/specializations/sustainable-cities

COURSE TITLE	DESIGN PROJECT-I			CREDITS	1
COURSE CODE	EAT51800	COURSE CATEGORY	EEC	L-T-P-S	0-0-2-6
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Review	Second Review	Third Review	Project Report & Viva Voce		
20%	20%	10%	50%		
Course Description	This course provides the student significant design experience with the knowledge and skills required to analyse the basic real time problem statement. This course provides an exposure to teamwork to emulate a typical professional design environment. Simulations are to be used both in the execution of the design methodology and the management of the design project.				
Course Objective	The course will enable the students to understand: 1. To develop literature survey and report preparation skills 2. To identify a project and execution of preliminary solution to address the problem statement 3. To enrich the communication and team management skills				
Course Outcome	Upon completion of this course, the students will be able to 1. Identify a real time problem by intensive literature survey 2. Selection of appropriate methodology with the required modern tools 3. Design & Analyse the solution through appropriate Measurement and scientific calculations				
Prerequisites: Basic knowledge in Measurements, Data Analysis, Interpretation.					

CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	
CO-1	3	3	2	1	3	2	1	3	3	3	3	2	1	2	
CO-2	3	3	2	1	3	2	1	3	3	3	3	2	2	3	
CO-3	3	3	2	1	3	2	1	3	3	3	3	2	3	2	

Weightage of Assessment:

Review / Examination Scheme	Weightage
First Review	20%
Second Review	20%
Third Review	10%
End Semester Viva Voce	50%

A committee will be constituted by the HoD for Review process

Assessment Rubrics

Parameter	Weightage (%)
Title & Objectives	5.0
Review of Literature (RL)	10.0
Design / Implementation	10.0
Methodology	5.0
Planning of Project Work	5.0
Testing Environment / Test Cases	5.0
Analytical thinking*	5.0
Technical Knowledge*	5.0
Presentation*	10.0
Demonstration*	5.0
Individual Roles Distribution* (Individual Objectives in the project work)	5.0
Individual Contributions* (Towards the individual objectives in the project work)	5.0
Deliverables	5.0
Team- work	10.0
Report / Thesis	5.0
Peer Assessment*	5.0

* - Attributes for individual contribution.

COURSE TITLE	INTERNSHIP – 1 (To be carried out in summer after 2 nd semester and evaluated in 3 rd semester)				CREDITS	1									
COURSE CODE	EAT51801	COURSE CATEGORY	EEC		L-T-P-S	0-0-0-2									
Version	1.0	Approval Details	36 TH ACM		LEARNING LEVEL	BTL-4									
ASSESSMENT SCHEME															
Visit Report, Feedback of the employer, Presentation & Viva Voce, MCQ Assessment															
100%															
Course Description	This course aims to inculcate the application of knowledge & skill learned through classroom practices. It demands the academic component consisting of research, reflection, written and oral skills of the learner.														
Course Objective	The course will enable the students to 1. Explore career alternatives prior to graduation. 2. Integrate theory and practice. 3. Assess interests and abilities in their field of study. 4. Build a record of work experience.														
Course Outcome	Upon completion of this course, the students will be able to 1. Choose appropriate modern tools used in the field of Automobile engineering to manage the resources effectively by applying innovative ideas 2. Demonstrate ethical conduct and professional accountability while working in a team for the benefit of society. 3. Communicate effectively and to write the scientific report of the learnings														
Prerequisites: Basic knowledge in Measurements, Data Analysis, Interpretation.															
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PS O-1	PS O-2	
CO-1	2	2	3	3	2	2	1	2	-	-	2	-	1	3	
CO-2	2	2	3	3	2	-	1	2	2	2	-	-	2	1	
CO-3	2	2	3	3	2	-	1	2	3	3	3	2	1	1	

Weightage of Assessment:

Assessment Scheme	Weightage
Presentation & Viva voce	50 %
Report	20 %
Feedback of the Employer	30%

A committee will be constituted by the HoD with Internship coordinator as head for learning assessment process

Assessment Rubrics

Performance Indicators	Excellent(5)	Good(4)	Fair(3)	Poor(2)
Requirement analysis and clarity on problem statement(5)	Requirement well understood and problem statement well defined	Requirement well understood but problem statement not well defined	Understood the requirement and not defined properly	Not properly understood the requirements and problem statement not defined properly
Relevance with Industry /Societal problem(5)	Relevant	Relevant to industry with small modifications	Partially relevant	Irrelevant
Project timeline scheduled(5)	Scheduled and followed strictly	Scheduled and but not followed strictly	Scheduled but not followed	Not Scheduled and not followed
Usage of latest application and software(5)	latest applications and software's are used	Moderate usage of new technology	Slightly outdated	No latest applications and software's used
Design and code efficiency(5)	Excellent design of experiment and all possible outcomes are handled	Effective design but all possible outcomes are not handled	Satisfactory Design	Irrelevant design
Report Preparation(10)	Excellent documentation	Good documentation	Average documentation	Poor documentation
Presentation skills, Fluency and comprehensibility(5)	Excellent communication skills and good comprehensibility	Good confidence , lack of communication skills and average comprehensibility	Less confidence, vocabulary need to be improved and poor comprehensibility	Poor skills
Slide organization and contents time conscious(5)	Content is organized properly and effective time management	Content is organized properly but not effective time management	Content is not organized properly	Poor organization and least time management
Feedback from Industry mentor(5)	Regular /novel idea/Excellent execution of project	Regular /Novel idea/Good execution of project	Regular /existing idea/Good execution of project	Irregular /existing idea/Poor execution of project

Semester-IV

COURSE TITLE	PROBABILITY AND STATISTICS					CREDITS			4						
COURSE CODE	EMA51007	COURSE CATEGORY		BS			L-T-P-S			3-1-0-2					
Version	1.0	Approval Details		36 th ACM			LEARNING LEVEL			BTL-3					
ASSESSMENT SCHEME															
CIA													ESE		
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project		Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”			Attendance			End Semester Examination					
15%	15%	10%		5%			5%			50%					
Course Description	To make the student understand the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science														
Course Objective	1. To describe the concept of probability and random variable 2. To identify the standard distribution variables. 3. To interpret the concepts of discrete and continuous random variables 4. To provide the types of hypothesis testing 5. To establish optimal process performance														
Course Outcome	Upon completion of this course, the students will be able to 1. Formulate theorems about the concept of probability and Calculate probabilities using Conditional probability. 2. Identify the standard distributions and apply them appropriately in real time problems. 3. Compute the covariance and correlation. 4. Classify the test of hypothesis and interpret statistical and practical significance. 5. Compute and interpret proportion of variance for ANOVA classification														
Prerequisites: Basics of Statistics															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	
CO-1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	
CO-2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	
CO-3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	
CO-4	3	3	2	2	-	-	-	-	-	1	1	1	-	-	

CO-5	3	3	2	2	-	-	-	-	-	1	1	1	-	-	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PROBABILITY AND RANDOM VARIABLES (9L+3T)															
Axioms of Probability- Bayes' Theorem -Random variables – Moments – Moment generating functions.												CO-1 BTL-3			
Suggested Reading: Basic Probability															
MODULE 2: STANDARD DISTRIBUTIONS (9L+3T)															
Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions												CO-2 BTL-3			
Suggested Reading: Discrete and Continuous Functions															
MODULE 3: TWO-DIMENSIONAL RANDOM VARIABLES (9L+3T)															
Joint distribution – Marginal and conditional distribution – Co-variance – Correlation and Regression												CO-3 BTL-3			
Suggested Reading: Random Variables															
MODULE 4: TESTING OF HYPOTHESIS (9L+3T)															
Sampling distributions – Testing of Hypothesis –Small samples– t Test, F Test and Chi-square Test – Large samples– Single mean– Difference in means– single proportion and difference in proportions.												CO-4 BTL-3			
Suggested Reading: Sampling Problems															
MODULE 5:DESIGN OF EXPERIMENTS (9L+3T)															
Analysis of variance– One Way Classification–Completely Randomized block design– Two Way Classification – Randomized block design – Latin Square design												CO-5 BTL-3			
Suggested Reading: Analysis of variance															
TEXT BOOKS															
1.	J. S. Milton and J. C. Arnold (2007) <i>Introduction to Probability and Statistics</i> , Tata McGraw Hill, 4th Edition, New Delhi.														
2.	R.A. Johnson, andC. B. Gupta (2015) <i>Miller and Freund's Probability and Statistics for Engineer</i> , 7th Edition, Pearson Education, Asia.														
3.	A. Chandrasekaran, and G.Kavitha (2014) <i>Probability, Statistics ,Random Processes and Queuing Theory</i> , Dhanam Publications, Chennai.														
4.	R. K. Bansal, A.K. Goel and M. K. Sharma (2016) <i>MATLAB and its Applications in Engineering</i> , Second Edition, Pearson Publication.														
REFERENCE BOOKS															
1.	M. R. Spiegel, J. Schiller and R. A. Srinivasan (2004) <i>Schaum's Outline of Theory and Problems of Probability and Statistics</i> , Tata McGraw Hill Edition.														
2.	J. L. Devore (2012) <i>Probability and Statistics for Engineering and the Sciences</i> , Cengage Learning, 8th Edition, New Delhi														
3.	D. G. Duffy (2013) <i>Advanced Engineering Mathematics with MATLAB</i> , Third Edition, CRC Press, Florida.														
E BOOKS															

1.	http://wiki.stat.ucla.edu/socr/index.php/Probability_and_statistics_EBook
MOOC	
1.	https://archive.nptel.ac.in/courses/111/105/111105090/

COURSE		PROFESSIONAL EDITING AND PROJECT WRITING						CREDITS				1		
COURSE CODE		GLS51004		COURSE CATEGORY			HS		L - T - P - S				2 – 0 – 0 - 1	
Version	1.0	Approval Details		36 th ACM					LEARNING LEVEL				BTL – 4	
ASSESSMENT SCHEME														
CIA												End Semester Examination (ESE)		
First Periodical Assessment	Second Periodical Assessment	Weekly assignment/ lab record and viva as approved by the Department Examination Committee “DEC”			Surprise Test / Quiz., as approved by the Department Examination Committee “DEC”			Attendance			Theory			
15 %	15 %	10 %			5 %			5 %			50%			
Course Description	Professional Editing and Project Writing is a course to help students develop their editing and writing skills for professional purposes. Topics include document structure, editing for clarity and accuracy, content types and project management. Students will edit documents, prepare presentations and develop writing projects. The course aims to help students understand the writing process and become more proficient in editing and writing for professional purposes.													
Course Objectives	1. To Copyedit written texts professionally and appropriately 2. To understand and respect the role of the author in the editing process 3. To carry out a constructive and appropriate structural edit of written texts 4. To understand the editorial and production processes for producing books and other texts 5. To identify the market and readership of a text													
Course Outcomes	Upon completion of this course, the students will be able to 1.Develop a comprehensive understanding of professional editing and project writing. 2.Effectively edit and revise documents for clarity, accuracy and consistency. 3.Demonstrate an understanding of the different types of content used in professional writing. 4. Construct coherent and well-structured documents for various audiences. 5.Gain experience in developing and delivering effective presentations.													
Prerequisites: Intermediate Level														
CO, PO AND PSO MAPPING														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	-	-	-	2	-	-	-	-	1	3	-	2		
CO2	-	-	-	2	-	-	-	-	1	3	-	2		
CO3	-	-	-	2	-	-	-	-	1	3	-	2		
CO4	-	-	-	2	-	-	-	-	1	3	-	2		
CO5	-	-	-	2	-	-	-	-	1	3	-	2		
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1– INTRODUCTION TO PROFESSIONAL EDITING AND PROJECT WRITING (6L)														

Writing: Academic writing and kinds, Non-academic writing and kinds, Ways to an Effective Writing, Review/Research/Project Writing. Editing: Basics of Editing and Steps Involved in Editing. Traits of an Editor and Copy Editor. Basics of Proof-reading		CO-1 BTL-2
MODULE 2 – MECHANICS OF WRITING- GRAMMAR, PUNCTUATION AND STYLE		(6L)
Reviewing the fundamentals of grammar, understanding common grammatical errors, Spelling, Punctuation, Capitalization, Italics, Names of Persons, Number, Vocabulary, Appropriate use of Abbreviations, Established Symbols. Dos & Don'ts of writing, Common Errors/Words often Confused. Exploring different writing styles, their appropriate usage and applying consistent style throughout a document		CO-2 BTL-3
MODULE 3 – RESEARCH AND WRITING		(6L)
Elements of Writing: Selecting a Topic, Conducting Research, Using Sources, Evaluating and Incorporating Sources, Developing Ideas, Gather data, Incorporate it into a project, Writing Clear and Effective Sentences and Paragraphs, Developing Unity, Coherence, Revisions; Format of Manuscripts, Academic Honesty and Plagiarism.		CO-3 BTL-3
MODULE 4 – DOCUMENTATION		(6L)
Documenting Sources, APA Style, Parenthetical documentation, List of works Cited, Figures, Charts and Tables, Endnotes, Footnotes, Citations components, Bibliography, and Appendices.		CO-4 BTL-3
MODULE 5 – EDITING		(6L)
Types and Stages, Roles, Duty and Responsibility of an Editor, Principles and Components of Editing, Functions of Editing, Copy Editing, Editing and Review, Developing Editorial Skills and Editorial Functions		CO-5 BTL-4
TEXT BOOKS		
1	Dade, P. (2020). The Oxford Guide to Effective Writing and Speaking. Reference Reviews, OUP. London.	
2.	Montagnes, I. (2018). Editing and publication: A training manual. Int. Rice Res. Inst..	
REFERENCE BOOKS		
1.	Strunk Jr, W., & White, E. B. (2007). The Elements of Style Illustrated. Penguin.	
2.	Blumenstock, N. A. (1984). The Chicago Manual of Style. By the University of Chicago Press. Chicago: University of Chicago Press, 1982. ix, 740 pp.	
3.	Lester, J. D., & Lester, J. D. (2005). Writing research papers: A complete guide. New York: Pearson/Longman.	
4	Saller, C. F. (2016). The subversive copy editor. In The Subversive Copy Editor, Second Edition. University of Chicago Press.	
E Books		
1.	https://edisciplinas.usp.br/pluginfile.php/3928474/mod_resource/content/1/Introduction%20to%20Academic%20Writing.pdf	
2.	https://www.routledge.com/rsc/downloads/A_Practical_Guide_to_Academic_Writing_for_International_Students-A_Routledge_FreeBook-_FINAL_VERSION_.pdf	
MOOC Courses		
1	https://www.coursera.org/specializations/academic-english	
2	https://www.coursera.org/learn/introduction-to-academic-writing	

COURSE TITLE	MECHANICS OF SOLIDS AND FLUIDS				CREDITS	4								
COURSE CODE	EAT51005	COURSE CATEGORY	PC	L-T-P-S	2-1-2-2									
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL- 4									
ASSESSMENT SCHEME														
CIA					ESE									
First Periodical Assessment	Second Periodical Assessment	Weekly assignment/ lab record and viva as approved by the Department Examination Committee “DEC”	Surprise Test /Lab Observation., as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical								
15%	15%	10%	5%	5%	25 %	25%								
Course Description	The first part of the course Solid Mechanics aims to provide an introduction to analysis of stress and strain in solid materials under axial, transverse and torsional loads. The second part of the course Fluid Mechanics aims to provide an introduction to fluid flow concepts and kinetics and kinematics of fluid flow.													
Course Objective	The course should enable the students to 1. To identify the concepts of simple stresses and strains for loads in axial direction. 2. To distinguish the types of beams and solving problems while transverse loads acting on it. 3. To derive the torsional equations and solve the numerical problems for torsional load on shafts. 4. To apply the concept of fluid flow. 5. To justify the losses on fluid flow through pipe line.													
Course Outcome	Upon completion of this course, the students will be able to 1. Apply the principles to solve solid bodies subjected to simple stresses 2. Identify the procedure to solve solid bodies subjected to transverse loading 3. Discuss by solving solid bodies subjected to torsional loading 4. Apply the basic concepts of fluid flow 5. Estimate losses on flow through circular conduit.													
Prerequisites:														
CO, PO AND PSO MAPPING														
CO - PO	PO - 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO - 10	PO- 11	PO- 12	PSO -1	PSO -2
CO-1	3	3	2	0	1	0	0	2	2	1	0	3	2	0
CO-2	3	3	3	0	1	0	0	2	2	1	0	3	2	0
CO-3	3	3	3	0	1	0	0	2	2	1	0	3	2	0
CO-4	3	3	0	0	0	0	0	2	2	0	0	3	2	0
CO-5	3	3	0	0	0	0	0	2	2	0	0	3	2	0
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1:	STRESS, STRAIN AND DEFORMATION OF SOLIDS											(6L+ 3T+6P)		

Concept of stress-strain, Hooke's law, Tension, Compression and Shear, stress-strain diagram, Poisson's relation, volumetric strain, Elastic constants and their relation. Stress in simple and composite bars subjected to axial loading and temperature. Practical component: Tension Test on Mild Steel Rod Compression Test on Wood or Concrete block Suggested Readings: Laws of mechanics, System of forces – parallelogram, triangle and polygon law of forces – resultant of a force system and Mechanical properties of Materials		CO-1 BTL-3
MODULE 2: TRANSVERSE LOADING ON BEAMS SHEAR FORCE AND BENDING MOMENT (6L+ 3T+6P)		
Types of Beams, Transverse loading on beams shear force and bending moment in beams – cantilever, simply supported, overhanging beam subjected to concentrated load and UDL – maximum bending moment and point of contra flexure. Practical component: Verification of Maxwell's Reciprocal Theorem for deflection of beam. Bending Test on Mild Steel Rod Suggested Readings: Theory of simple bending and its assumptions		CO-2 BTL-3
MODULE 3: TORSION, SPRINGS AND COLUMNS (6L+ 3T+6P)		
Theory of torsion and assumption – Torsion of circular shafts, solid & hollow – strain energy in torsion. Power transmission, strength and stiffness of shafts. Types of springs, stiffness stresses and deflection in helical spring and leaf spring. Practical component: Torsion test on Mild Steel Rod Compression Test on open coil Helical spring Suggested Readings: Applications of Torsional loads on shafts and suspension systems in vehicles		CO-3 BTL-3
MODULE 4: FLUID FLOW CONCEPTS AND BASIC EQUATIONS (6L+ 3T+6P)		
Flow characteristics, concepts of system and control volume – continuity equation – Application of control volume to continuity – Energy Equation – Bernoulli equation and Momentum Equation –simple problems. Practical component: Calibration of Venturi Meter. Calibration of Orifice Meter. Calibration of Rotometer Suggested Readings: Properties of fluids, Units and dimensions.		CO-4 BTL- 3
MODULE 5: FLOW THROUGH CIRCULAR CONDUITS (6L+ 3T+6P)		
Fluid flow – Laminar and Turblent flow through circular tubes. Darcy Equation on pipe roughness – Friction factor –Moody diagram, Minor loss. Practical component: Determination of Friction coefficients in pipe. Suggested Readings: Flow characteristics and its applications		CO-5 BTL- 3
TEXT BOOKS		
1	Ramamurtham .S and Narayanan .R. Strength of material, Dhanpat Rai Pvt. Ltd., New Delhi, 2001.	
2	Bansal. R.K. Strength of Material, Lakshmi publications Pvt. Ltd., New Delhi, 2004.	
3	Bansal .R.K Fluid Mechanics and Hydraulic Machines Laxmi publications (P) Ltd., New Delhi,2014.	
REFERENCE BOOKS		

1	Kumar .K.L., Engineering Fluid Mechanics, Eurasla publishers Home Ltd., New Delhi, 2006.
2	Ramamurthan .S. Fluid Mechanics and Hydraulics Dhanpat Rai and Sons, Delhi, 1988.
E BOOKS	
1	https://www.kobo.com/us/en/ebook/fluid-and-solid-mechanics
MOOC	
1	https://nptel.ac.in/courses/112/107/112107146/
2	https://nptel.ac.in/courses/112/105/112105171/

COURSE TITLE	AUTOMOTIVE CHASSIS AND DRIVELINE SYSTEM			CREDITS	3	
COURSE CODE	EAT51006	COURSE CATEGORY	PC	L-T-P-S	2-0-2-2	
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment	Second Periodical Assessment	Weekly assignment/ lab record and viva as approved by the Department Examination Committee “DEC”	Surprise Test / Quiz/Lab., as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25 %	25%
Course Description	This course will provide basic knowledge on automotive chassis and its structures including vehicle body types. In addition, the course deals with components associated with chassis including driveline, braking, suspension and steering systems.					
Course Objectives	1. To investigate new and emerging technologies in automotive chassis 2. To identify various front axles and steering systems 3. To discuss about various types of propeller Shaft, differential and Rear Axles 4. To classify and describe different typologies of suspension systems 5. To impart knowledge on detailed concept and types of braking systems					
Course Outcomes	Upon the completion of this course, the students will be able to 1. Identify and select a suitable chassis for a vehicle 2. Analyze steering effort and rolling motion for steering mechanism 3. Apply driving forces and develop transmission lines for maximum torque transfer 4. Identify suitable suspension and materials for a vehicle 5. Design and identify suitable braking system for a vehicle					
Prerequisites: Nil						
CO, PO AND PSO MAPPING						

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	3	3	3	1	2	2	1	2	-	-	2	3	3	3
CO-2	3	3	3	2	2	2	-	2	-	-	2	3	3	1
CO-3	3	3	3	2	2	2	-	2	-	-	1	3	3	3
CO-4	3	3	3	2	2	2	1	1	-	-	2	3	3	1
CO-5	3	3	3	2	2	3	1	2	-	-	2	3	3	2
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction to Chassis													(6L+6P)	
Types of chassis layout with reference to power plant locations and drives, vehicle frames, various types of frames, constructional details, materials, testing of vehicle frames, unitized frame body construction and vehicle body styles. Lab Practice: Measurement of Chassis dimensions, study of different types of chassis													CO-1 BTL-1	
Module 2 – Front Axle and Steering System													(6L+6P)	
Types of front axles, construction details, materials, front wheel geometry: castor, camber, king pin inclination, toe-in. conditions for true rolling motion of wheels during steering, steering geometry, Ackermann steering system, constructional details of steering linkages, different types of steering gear boxes, steering linkages and layouts, turning radius, wheel wobble, power assisted steering, steering of crawler tractors and Electronic Steering System. Lab Practice: Dismantling and assembling of front axle, steering system, measurement of front wheel geometry.													CO-2 BTL-3	
Module 3 – Drive Line													(6L+6P)	
Hotchkiss drive, torque tube drive and radius rods, propeller shaft, universal joints, front wheel drive, different types of final drive, double reduction and twin speed final drives, differential principle, construction details of differential unit, non-slip differential, differential locks, differential housings, construction of rear axles, types of loads acting on rear axles, types of rear axles, rear axle housing, construction of different types of axle housings, multi axle vehicles, wheels and tyres. Lab Practice: Dismantling and assembling of final drive, differential, rear axle, wheels and tyres.													CO-3 BTL-3	
Module 4 – Suspension System													(6L+6P)	
Need of suspension system, types of suspension, suspension springs, constructional details and characteristics of leaf, coil and torsion bar springs, rubber suspension, pneumatic suspension, shock absorbers, independent suspension, semi-active and active suspension system. Lab Practice: Dismantling and assembling of suspension systems- leaf spring, coil spring, torsion bar and shock absorbers.													CO-4 BTL-2	
Module 5 – Braking System													(6L+6P)	
Classification of brakes, drum brakes and disc brakes, constructional details, theory of braking, concept of dual brake system, parking brake, material, hydraulic system, vacuum													CO-5 BTL-2	

assisted system, air brake system, antilock braking system, retarded engine brakes, eddy retarders and electronic braking system.		
Lab Practice:		
Dismantling and assembling of drum brakes, disc brakes and other brake systems.		
TEXT BOOKS		
1.	James D. Halderman , ‘Automotive Chassis Systems’ , Pearson Series, 2017	
2.	Kirpal Singh – ‘Automobile Engineering, Vol.1’- Standard Publishers Distributors , New Delhi.	
3.	N.K. Giri – Automobile Engineering - Khanna Publishers – 2015	
REFERENCE BOOKS		
1.	D. G. Thomas, Fundamentals of Vehicle Dynamics, 2nd edn. Society of Automotive Engineers, 2021	
2.	Heldt.P.M, “Automotive Chassis”, Chilton Co., New York, June 2012	
3.	Tim Gilles, “Automotive Chassis”, CENGAGE Delmar Learning, 2004.	
E BOOKS		
1.	https://shop.elsevier.com/books/the-automotive-chassis-engineering-principles/reimpell/978-0-7506-5054-0	
2.	https://link.springer.com/book/10.1007/978-3-030-35635-4	
3.	https://link.springer.com/book/10.1007/978-94-017-8533-4	
MOOC		
1.	https://www.mtu.edu/engineering/graduate/certificates/vehicle-dynamics/	
2.	https://www.coursera.org/lecture/intro-self-driving-cars/lesson-1-introduction-to-lateral-vehicle-control-pTs75	
3.	https://nptel.ac.in/courses/107106080/	

COURSE TITLE	TWO AND THREE-WHEELER EV TECHNOLOGY (Industry Collaborated Course)			CREDITS	3	
COURSE CODE	EAT51007	COURSE CATEGORY	PC	L-T-P-S	2-0-2-2	
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment	Second Periodical Assessment	Weekly assignment/ lab record and viva as approved by the Department Examination Committee “DEC”	Surprise Test / Quiz/Lab as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25 %	25%
Course Description	This course will enable the students to develop students’ skills making them competent and a flag ship Engineer in the EV market.					

Course Objectives	1. To recall concepts of electric vehicle & performance of electric vehicles. 2. To identify Battery Technologies 3. To recognize on motor and controllers 4. To describe the charging technologies 5. To evaluate the troubleshooting techniques													
Course Outcomes	Upon completion of this course, the students will be 1. Recall concepts of electric vehicle & performance of electric vehicles. 2. Identify Battery Technologies 3. Recognize on motor and controllers 4. Describe the charging technologies 5. Evaluate the troubleshooting techniques													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	2	0	0	0	1	0	0	0	0	0	0	0	1	1
CO-2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
CO-3	0	0	0	0	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	0	1	0	0	0	0	0	0	0	1	2
CO-5	0	0	3	0	1	0	0	0	0	0	0	0	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – ELECTRIC VEHICLES													(6L+6P)	
Comparing ICE and Electric Vehicles – History, Impact on Environment – EV Power trains & its sizing - Well to Wheel concept - Regenerative braking – Types of EV. Lab : Dismantling of Electric Vehicle and its components, Assembling of Electric Vehicle and its components													CO-1 BTL-3	
Module 2 – BATTERY TECHNOLOGY													(6L+6P)	
Terminology and Description about Integral part of a BEV, Battery Technology and Innovation in Automotive Batteries for Dynamic Applications. Lab : Testing of the EV Battery													CO-2 BTL-3	
Module 3 – MOTOR AND CONTROLLERS													(6L+6P)	
Propulsion System – Traction Motor / Hub Motor, Battery Management System and Electronics Controller-Fast charging and its limitations - Smart charging and applications - Vehicle to grid (V2G) technology. Lab : Testing of HUB Motor													CO-3 BTL-3	
Module 4 – CHARGING TECHNOLOGY													(6L+6P)	
EV Charging – External and On Board Chargers. Various Methods of Charging-AC charging - Type 1,2,3. Lab : Testing of charging EV system													CO-4 BTL-3	
Module 5 –Future trends in electric cars													(6L+6P)	
Wireless and on-road charging of EV- Battery swap technology- Autonomous driving- Charging EVs from renewable.													CO-5 BTL-4	

Lab : Fault diagnostics of a EV system	
TEXT BOOKS	
1.	Longo, Stefano, et al. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles. United States, CRC Press, 2018.
2.	James Larminie and John Lory, "Electric Vehicle Technology-Explained", John Wiley & Sons Ltd., 2013.
REFERENCE BOOKS	
1.	Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680-9567-8.
2.	Tom Denton., "Electric and Hybrid Vehicles"2020.
E BOOKS	
1.	https://shorturl.at/ahvAJ
2.	https://shorturl.at/arxzH
MOOC	
1.	https://elearn.nptel.ac.in/shop/iit-workshops/completed/e-mobility-and-electric-vehicle-engineering/
2.	https://nptel.ac.in/courses/108106170

COURSE TITLE		DESIGN PROJECT-2								CREDITS		1		
COURSE CODE		EAT51802		COURSE CATEGORY		EEC		L-T-P-S		0-0-2-6				
Version		1.0		Approval Details		36th ACM		LEARNING LEVEL		BTL-4				
ASSESSMENT SCHEME														
First Review		Second Review		Third Review		Project Report & Viva Voce								
20%		20%		10%		50%								
Course Description		This course provides the student significant design experience with the knowledge and skills required to analyse the real time problem statement. This course provides an exposure to emulate a typical professional development of solution as a team. Appropriate Simulation tools to be used in the execution of the design methodology. The resources and team management skills are utilised to develop an innovative, economic solution to the selected problem												
Course Objective		The course will enable the students to: 1. Explore the literature study and report preparation skills 2. Demonstrate project identification and execution of feasible solution to address the problem statement 3. Elucidate the communication and team management skills												
Course Outcome		Upon completion of this course, the students will be able to 1. Identify a real-time problem by intensive literature survey 2. Selection of appropriate methodology by using modern tools 3. Design & analyse the solution through appropriate Measurements and calculations												
Prerequisites: Design Project-1														
CO, PO AND PSO MAPPING														
COs	PO -1	PO- 2	PO - 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO - 10	PO- 11	PO- 12	PSO -1	PSO -2

CO-1	3	3	2	2	3	2	2	3	3	3	3	1	1	1
CO-2	3	3	3	2	3	2	2	3	3	3	3	1	2	1
CO-3	3	3	3	2	3	2	2	3	3	3	3	1	1	1

Weightage of Assessment:

Review / Examination Scheme	Weightage
First Review	20%
Second Review	20%
Third Review	10%
End Semester Viva Voce	50%

A committee shall be constituted by the HoD for the Review.

Assessment Rubrics

Parameter	Weightage (%)
Title & Objectives	5.0
Review of Literature (RL)	10.0
Design / Implementation	10.0
Methodology	5.0
Planning of Project Work	5.0
Testing Environment / Test Cases	5.0
Analytical thinking*	5.0
Technical Knowledge*	5.0
Presentation*	10.0
Demonstration*	5.0
Individual Roles Distribution* (Individual Objectives in the project work)	5.0
Individual Contributions* (Towards the individual objectives in the project work)	5.0
Deliverables	5.0
Team- work	10.0
Report / Thesis	5.0
Peer Assessment*	5.0

* - Attributes for individual contribution.

EVALUATION PARAMETERS FOR ASSESSMENT

To be followed same as approved for Design project 1

COURSE TITLE		Personality Development and Soft Skill Techniques				CREDITS		2						
COURSE CODE		ETP51853		COURSE CATEGORY		EEC		L - T – P – S		0- 0 -3- 2				
Version	1.0	Approval Details		41 ACM Dt. 13 Jul 24				LEARNING LEVEL		BTL -4				
ASSESSMENT SCHEME														
CIA										ESE				
First Periodical Assessment	Second Periodical Assessment	Practical Assessments as approved by the Department Examination Committee “DEC”			Observation / lab records as approved by the Department Examination Committee “DEC”			Attendance	Practical					
15%	15%	10 %			5%			5 %	50%					
Course Description		This course aims to enhance students' understanding and application of essential skills for personal and professional growth. It delves into the intricacies of personality development and soft skills, providing students with the knowledge and tools necessary to excel in various aspects of life.												
Course Objective		1.To understand the concept of self-awareness and its importance in personal and professional development. 2.To recognize the significance of setting clear, specific, and achievable goals inpersonal and professional contexts. 3.To explore a variety of time management techniques, such as prioritization, goalsetting, and task scheduling. 4.To learn strategies for managing and regulating emotions effectively in varioussituations. 5.To acquire skills in critical thinking, problem-solving, and decision-making tonavigate complex challenges and opportunities.												
Course Outcome		Upon completion of this course, the students will be able to 1. Identify their strengths and areas for growth, leading to improved self-confidence and self-efficacy. 2. Demonstrate the ability to prioritize goals based on importance, urgency, and alignment with their values and long-term aspirations. 3. Analyze the ability to manage their time effectively, resulting in increasedproductivity and efficiency in academic, professional, and personal tasks. 4. Develop stronger interpersonal relationships characterized by empathy, understanding, and effective communication, leading to enhanced collaboration andteamwork. 5. Apply effective networking skills, building and nurturing relationships with stakeholders, mentors, and peers to support personal and organizational growth.												
Prerequisites: Plus Two English-Intermediate Level														
CO, PO AND PSO MAPPING														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	1	2	-	3	1	1
CO2	-	-	-	-	-	-	-	2	2	2	-	3	1	1
CO3	-	-	-	-	-	-	-	2	2	2	-	3	0	1

CO4	-	-	-	-	-	-	-	-	1	2	2	3	1	2
CO5	-	-	-	-	-	-	-	-	2	2	2	3	1	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 : SELF AWARENESS AND ATTITUDE													(9P)	
Understanding Yourself: Personality Assessment Test – Understanding of the Self- Self Analysis through SWOT Method- Self-Grooming-Personal Branding – Attitude Building: The power of positive thinking – Positive self-talk –self-esteem and positive attitude - Attitude at the workplace-Etiquette and manners in the class, public and professional places–Self-analysis through Johari Window. Practicum: 1. Students will be asked to enact a role play of a situation to build a positive attitude. 2.Prepare a case study on the personality traits of the students in collegeby SWOT Analysis Method.													CO-1BTL-2	
MODULE 2: GOAL SETTING													(9P)	
GOAL SETTING: What is goal? - What are SMART goals? - How does SMART goal setting work? - Goals as commitment – Useful Guideline for goal setting – Trying personal and professional goals – Goals at the workplace – Cascading goals – Types of goals Practicum: 1. Identify three goals you need to set to take you towards your dream job. Then list the steps you would take to reach that ultimate goal. 2.Students will be asked to set SMART goal of each type for the current academic year.													CO-2BTL-3	
MODULE 3: TIME AND STRESS MANAGEMENT													(9P)	
Time Management: What is time management? Prioritization – Time stressors – Time stealers – Coming out of Procrastination-Eisenhower Matrix– Strategies for effective time management – productivity pyramid – The four Ds of time management. Stress Management– Understanding stress-Identifying Stressors- Effects and Symptoms of Stress, Techniques of Stress Management Practicum: 1. Read Stephen Covey’s demonstration of the concept of time and prepare the schedule based on your daily activity. 2.Prepare a case study based on Time management during chess game.													CO-3BTL-3	
MODULE 4: EMOTIONAL INTELLIGENCE													(9P)	
EMOTIONAL INTELLIGENCE: What is Emotional Intelligence? Enhancing your emotional self-awareness, - Emotional intelligence and change management –Rewiring the Brain: unfreezing the old, re-freezing the new– emotional intelligence – Emotional Intelligence Test -Crisis management. Practicum: Prepare a case study of why concept of emotional intelligence is important on organizational setting.													CO-4BTL-3	
MODULE 5: LEADERSHIP AND CHANGE MANAGEMENT													(9P)	
LEADERSHIP: Qualities of a leader – Leadership and assertiveness – problem –solving and decision-making – Creative Thinking-Approaches to problem – solving and decision-making – Brainstorming –Cause-and-effect analysis- Building Self Confidence – Overcoming fear and anxiety- Understanding Change Management Practicum: 1. Identify any one individual from around you who you think is a good leader. How many of the above qualities does he/she possesses? Give evidence for each quality. 2.Visualization Relaxation exercises.													CO-5BTL-4	
TEXT BOOKS														
1	Pillai, Sabina., & Fernandez, Agna. (2018). <i>Soft Skills & Employability Skills</i> . Cambridge University Press. India.													
REFERENCE BOOKS														
1.	Mitra K Barun. (2011). <i>Personality Development and Soft Skills</i> . Oxford University Press. New Delhi.													
1.	Dhanavel. S P (2018). <i>English and Soft Skills</i> . Orient Black Swan. India.													

2.	Goldsmith, Marshall & M.S. Rao.(2020) Soft Skills: <i>Enhancing Employability</i> . Dream tech Press. India.
E Books	
1.	http://dspace.vnbrims.org:13000/jspui/bitstream/123456789/4733/1/Leadership%20The%20Power%20of%20Emotional%20Intelligence.pdf
MOOC Courses	
1.	https://www.coursera.org/specializations/people-and-soft-skills-for-professional-success

SEMESTER V

COURSE TITLE		LOGICAL REASONING AND VERBAL ABILITY					CREDITS		1						
COURSE CODE		ETP51852		COURSE		EEC		L-T-P-S		1- 0 -2- 1					
Version		1.0		Approval Details		41ACM Dt. 13 Jul 24		LEARNIN G LEVEL		BTL 3					
CIA									ESE						
First Periodical Assessment	Second Periodical Assessment	Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”			Attenda nce	Theory	Practical						
15%	15%	10%		5%			5%	25%	25%						
Course Description		This course is an in-depth exploration of reasoning and verbal aptitude, essential skills for placement. Students will engage with a variety of verbal reasoning problems, logical puzzles, and language comprehension exercises designed to enhance their analytical capabilities and linguistic proficiency.													
Course Objective		1. Develop the ability to analyze, evaluate, and synthesize information. 2. Practice solving verbal reasoning puzzles and problems. 3. Strengthen abilities in reading comprehension and textual analysis. 4. Engage with various forms of logical reasoning, including deductive and inductive reasoning.													
Course Outcome		At the end of the course the students will be able to: 1. Apply arithmetic operations to solve complex problems. 2. Simplify and solve equations and inequalities. 3. Analyze and interpret data presented in various formats, including charts, graphs, and tables. 4. Solve geometric problems involving shapes, volumes, and areas. 5. Decipher quantitative problems with effective strategies and logical reasoning.													
Prerequisites: Plus Two English-Intermediate Level															
CO, PO AND PSO MAPPING															
CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	-	-	-	-	-	-	-	2	1	2	-	3	1	2	

CO2	-	-	-	-	-	-	-	2	2	2	-	3	1	1	
CO3	-	-	-	-	-	-	-	2	2	2	-	3	1	2	
CO4	-	-	-	-	-	-	-	-	1	2	2	3	1	1	
CO5	-	-	-	-	-	-	-	-	2	2	2	3	1	2	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1 : General Mental Ability-I (3L + 6P)															
Analogy- Classification-Series Completion-Coding, Decoding- Blood Relations-Puzzle test- Sequential Output Tracing-Direction Sense-Logical Venn Diagram-Alphabet Test- Number, Ranking and Time Sequence Test														CO-1	
														BTL-2	
MODULE 2 : General Mental Ability-II (3L + 6P)															
Mathematical Operations-Logic Sequence of Words-Arithmetical Reasoning-Inserting the missing Character-Data Sufficiency – Decision Making- Assertion and Reason, Situation Reaction Test- Verification of the truth of the Statement														CO-2	
														BTL-3	
MODULE 3 : Logical Reasoning -I (3L + 6P)															
Logic- Statement: Arguments- Statement: Assumptions-Statement: Course of Actions-Statement: Conclusions- Deriving Conclusion from the Passage- Theme Detection- Question: Statements-Series-Analogy-Classification														CO-3	
														BTL-3	
MODULE 4 : Logical Reasoning -II (3L + 6P)															
Analytical Reasoning-Mirror & Water Images-Embedded figures-Completion of Incomplete patterns- Figure Matrix- Paper folding and Paper cutting-Grouping of Identical figures- Cubes and Dice-Construction of Triangles and Squares-Figure formation and Analysis														CO-4	
														BTL-3	
MODULE 5 : Verbal Ability (3L + 6P)															
Reading Comprehension-Sentence Completion-Sentence correction-spotting errors-Synonyms and Antonyms-Filling the blanks-One word substitution-Idioms and Phrases-Filling with correct parts of speech-Identifying spelling errors-Arranging the sentences in a logical way														CO-5	
														BTL-3	
TEXT BOOK															
1	Sharma, Arun & Upadhyay, Meenakshi (2020). How to Prepare For Verbal Ability And Reading Comprehension. New Delhi: McGraw Hill.														
REFERENCE BOOK															
1.	Aggarwal, RS (2018). A Modern Approach to Verbal & Non-Verbal Reasoning. New Delhi: S. Chand.														

COURSE TITLE	AUTOMOTIVE SYSTEM DESIGN			CREDITS	4
COURSE CODE	EAT51008	COURSE CATEGORY	PC	L-T-P-S	2-1-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
CIA				ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the	Attendance	Theory Practical

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Study of loads, moments and stresses on Chassis frame members, design procedure of ladder type chassis frame, design procedure of leaf spring, coil spring and torsion bar spring. Lab Experiments 1. Modelling of chassis frame 2. Modelling of leaf spring, coil spring Software/Equipment Required Solid works Modelling software	CO-4 BTL-4
MODULE 5: DESIGN OF FRONT AXLE AND STEERING SYSTEM (6L+ 3T+6P)	
Study of loads on front axle, design procedure of front axle; Condition for true rolling motion, Ackermann steering principles, calculation of turning circle radius. Lab Experiments 1. Modelling of front axle 2. Modelling of steering system Software/Equipment Required Solid works Modelling software	CO-5 BTL-4
BOOKS	
1.	Giri.N.K- "Automobile Mechanics"- Khanna Publisher, New Delhi- 2012
2.	R.S Khurmi and J.K Gupta, "Machine Design", Eurasia Publishing house Pvt Ltd, New Delhi, 2015
REFERENCE BOOKS	
1	Julian Happian, <i>An Introduction to Modern Vehicle Design</i> -Smith. Edition, Publisher, SAE International, 2014.
2	John Fenton, <i>Handbook of Vehicle Design Analysis</i> , Published by Society of Automotive Engineers Inc, 2016
E Resources for Reference	
1.	http://ebooks.asmedigitalcollection.asme.org/book.aspx?bookid=277
2.	http://160592857366.free.fr/joe/ebooks/Mechanical%20Engineering%20Books%20Collection
MOOC	
1.	https://www.mooc-list.com/tags/machine-design

COURSE TITLE	MECHANICS OF MACHINES			CREDITS	3
COURSE CODE	EAT51009	COURSE CATEGORY	PC	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	Theory Practical
15%	15%	10%	5%	5%	25% 25%
Course Description	This course includes the various mechanisms involved in the machines and their applications.				
Course Objective	1. To analyze the types of mechanism involved in automobiles 2. To apply the concept of friction in various drives 3. To design and analyze a gear train for automobile application 4. To evaluate the balancing of reciprocating and rotary masses 5. To design Cam profile for various applications, governors for various applications.				

Course Outcome	Upon completion of this course, the students will be able to 1. Discuss on various mechanisms in applications. 2. Identify friction in various equipment while performing the operation. 3. Formulate and design the gear train with respect to a particular application. 4. Design balancing weight as per the movement of the equipment. 5. Apply the utilization of cams and governors with respect to automotive.													
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	1	1	1	1	3	1	1	2	2	2	2
CO-2	2	3	1	1	1	2	2	3	3	1	2	2	1	2
CO-3	3	2	0	1	2	2	2	3	3	1	2	2	2	1
CO-4	1	3	1	1	1	1	2	3	3	1	2	2	1	2
CO-5	3	1	1	1	2	2	2	3	3	1	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: MECHANISMS													(6L+ 6P)	
Machine & Structure – Kinematic link, pair and chain – Grublers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration for simple mechanisms. Lab Experiment: 1. To study various types of kinematics links, pairs, chains & mechanisms, 2. To study different types of chains and their inversions, 3. To find the velocity and acceleration of various links/points in slider-crank Mechanism using Klein’s construction method Equipment Required: 1. Slider crank mechanism 2. Double rocker mechanism													CO-1 BTL-3	
MODULE 2: FRICTION													(6L+ 6P)	
Friction in screw and nut – Pivot and collar – Thrust bearing– Belt and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission. Lab Experiment: 3. Calculation of power transmission through flat belt drive 4. Calculation of power transmission through V belt drive Equipment Required 1. Flat Belt drive set up 2. V belt drive set up													CO-2 BTL-3	
MODULE 3: GEARS													(6L+ 6P)	
Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound and epi-cyclic gear trains - Determination of speed and torque Lab Experiment: 1. Calculating gear ratio for sliding mesh gear box 2. Calculating gear ratio for constant mesh gear box Equipment Required 1. Sliding mesh gear box 2. Constant mesh gear box													CO-3 BTL-3	
MODULE 4: BALANCING													(6L+ 6P)	
Static and dynamic balancing – Single and several masses in different planes – Balancing of reciprocating and rotary masses - primary balancing and secondary balancing Lab Experiment: 1. Balancing of shaft 2. Balancing of crank shaft Equipment Required 1. Shaft													CO-4 BTL-3	

2. Crank shaft		
MODULE 5: CAM AND GOVERNOR		(6L+ 6P)
Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions. Governors - Basics of governors and its types. Lab Experiment: 1. Study on different cams and followers 2. Study on different governors Equipment Required: 1. Cams 2. Governors		CO-5 BTL-3
BOOKS		
1.	Ballaney.P.L, “Theory of Machines”, Khanna Publishers, New Delhi, 2012	
2.	R.S. Khurmi and J.K. Gupta, “Theory of Machines”, S.Chand & Co-2015	
REFERENCE BOOKS		
1	Rao J.S and Dukkupati, R.V, “Mechanism and Machine Theory”, Second Edition, Wiley Eastern Ltd., 2012.	
2	Malhotra, D.R and Gupta, H.C, “Theory of Machines”, SatyaPrakasam, Tech. India Publications.	
E Resources for Reference		
1	https://ftp.idu.ac.id/wp-content/uploads/ebook/tdg/DESIGN%20SISTEM%20DAYA%20GERAK/Theory%20of%20Machines%20and%20Mechanisms%20(%20PDFDrive%20).pdf	
2	https://www.academia.edu/43543661/R_S_KHURMI_A_Textbook_of_Theory_of_Mach	
MOOC		
1	https://www.classcentral.com/course/swayam-kinematics-of-mechanisms-and-machines-13022	
2	https://unacademy.com/course/theory-of-machines-473/KW3UHY0N	

COURSE TITLE	AUTOMOTIVE ELECTRICAL AND ELECTRONICS			CREDITS	3
COURSE CODE	EAT51010	COURSE CATEGORY	PC	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory Practical
15%	15%	10%	5%	5%	25% 25%
Course Description	This course will explain with lead acid battery and accessories, construct the starting system and charging system, to recognize automotive electronics, sensors and activators				
Course Objectives	- To recall the lead acid battery and accessories. - To identify the starting system. - To recognize on charging system. - To describe automotive electronics. - To choose sensors and activators.				
Course Outcomes	Upon completion of this course, the students will be - Discuss on the fundamental the lead acid battery and accessories. - Identify the starting system.				

	3. Apply concept on charging system. 4. Develop automotive electronics. 5. Discuss on sensors and activators.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	1	0	0	0	1	0	0	0	0	0	0	0	1	1
CO-2	1	0	0	0	0	0	0	0	0	0	0	0	1	2
CO-3	0	0	0	0	0	1	0	0	0	0	0	0	1	0
CO-4	0	0	0	0	1	0	0	0	0	0	0	0	1	2
CO-5	0	0	3	0	1	0	0	0	0	0	0	0	0	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – BATTERIES AND ACCESSORIES													(6L+6P)	
Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, headlight dazzling, current trends in the lighting system and preventive methods - Horn, wiper system Lab : Testing of Lead acid battery													CO-1 BTL-3	
Module 2 – STARTING SYSTEM													(6L+6P)	
Condition at starting, behaviour of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches. Lab : Starter motor testing													CO-2 BTL-3	
Module 3 – CHARGING SYSTEM													(6L+6P)	
Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cut out, Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments. Lab : Alternator Testing													CO-3 BTL-3	
Module 4 – FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS													(6L+6P)	
Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system. Lab : Fault finding of relay & fuses in car using Off Board Diagnostics Systems (OBDS).													CO-4 BTL-3	
Module 5 – SENSORS AND ACTUATORS													(6L+6P)	
Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay. Lab : Fault finding location of sensor in car using OBDS													CO-5 BTL-4	
TEXT BOOKS														

1.	William B. Ribbens., "Understanding Automotive Electronics an Engineering Perspective" Eighth Edition. 2017
2.	Tom Denton., "Automobile Electrical and Electronic Systems" 5th edition 2017.
REFERENCE BOOKS	
1.	Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680-9567-8.
2.	Tom Denton., "Electric and Hybrid Vehicles"2020.
E BOOKS	
1.	https://shorturl.at/qFJRT
2.	https://shorturl.at/kq019
MOOC	
1.	https://shorturl.at/tFQW1
2.	https://nptel.ac.in/courses/108106170

COURSE TITLE	DESIGN PROJECT-3			CREDITS	1
COURSE CODE	EAT51803	COURSE CATEGORY	EEC	L-T-P-S	0-0-2-6
Version	1.0	Approval Details	36th ACM	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Review	Second Review	Third Review	Project Report & Viva Voce		
20%	20%	10%	50%		
Course Description	This course provides the student significant design experience with the knowledge and skills required to analyse the real time problem statement and gives a strong Engineering and Practical foundation for understanding the different types of social problems and its solution based on engineering knowledge. This course is suitable for general engineering students to understand the importance of engineering concepts and its relevant applications. Different Simulation tools to be used in the execution of the design methodology. The resources and team management skills are utilized to develop an innovative, economic solution to the selected problem.				
Course Objective	The course will enable the students to: 1. Explore the literature study and report preparation skills 2. Demonstrate project identification and execution of feasible solution to address the problem statement 3. Elucidate the communication and team management skills				
Course Outcome	Upon completion of this course, the students will be able to 1. Identify a real-time problem by intensive literature survey 2. Selection of appropriate methodology by using modern tools 3. Design & analyse the solution through appropriate Measurements and calculations				
Prerequisites: Design Project -2					

CO, PO AND PSO MAPPING														
	PO - 1	PO - 2	PO - 3	PO - 4	PO - 5	PO - 6	PO - 7	PO - 8	PO - 9	PO - 10	PO - 11	PO - 12	PSO - 1	PSO - 2
CO-1	3	3	2	2	3	2	2	3	3	3	3	1	1	1
CO-2	3	3	3	2	3	2	2	3	3	3	3	1	2	2
CO-3	3	3	3	2	3	2	2	3	3	3	3	1	1	1

Weightage of Assessment:

Review / Examination Scheme	Weightage
First Review	20%
Second Review	20%
Third Review	10%
End Semester Viva Voce	50%

A committee shall be constituted by the HoD for the Review.

Assessment Rubrics

Parameter	Weightage (%)
Title & Objectives	5.0
Review of Literature (RL)	10.0
Design / Implementation	10.0
Methodology	5.0
Planning of Project Work	5.0
Testing Environment / Test Cases	5.0
Analytical thinking*	5.0
Technical Knowledge*	5.0
Presentation*	10.0
Demonstration*	5.0
Individual Roles Distribution* (Individual Objectives in the project work)	5.0
Individual Contributions* (Towards the individual objectives in the project work)	5.0
Deliverables	5.0
Team- work	10.0
Report / Thesis	5.0
Peer Assessment*	5.0

* - Attributes for individual contribution.

EVALUATION PARAMETERS FOR ASSESSMENT

To be followed same as approved for Design project 1

COURSE TITLE		ENTREPRENEURSHIP						CREDITS		2				
COURSE CODE		EGE51004		COURSE CATEGORY		ES		L-T-P-S		2-0-0-6				
Version		1.0		Approval Details		36 th ACM		LEARNING LEVEL		BTL-3				
ASSESSMENT SCHEME														
CIA										ESE				
First Periodical Assessment		Second Periodical Assessment		Seminar/Assignments/Project		Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC””		Attendance						
15%		15%		10%		5%		5%						
15%		15%		10%		5%		5%						
Course Description		The students shall develop a detailed insight about various aspects of Entrepreneurship. Knowledge and Skill levels of Entrepreneur will be discussed in the Module I, whereas stake holders policies were briefed in the Module II. Detailed procedure of preparing a business plan will be taught in the Module III, mobilization of various resources will be discussed in the Module IV. Finally, Module V will provide insights about monitoring and evaluation of business.												
Course Objective		1. The course aims to utilize the basic concepts of Entrepreneurship 2. The course also equips the students to Identify the internal and external environments of new businessventure 3. The course aims to prepare organizational goals of new business 4. The course also trains the students to build strategic approaches to succeed in the start-up												
Course Outcome		Upon completion of this course, the students will be able to 1. Utilize the basic concepts of Entrepreneurship 2. Identify the internal and external environments of new business venture 3. Prepare organizational goals of new business 4. Build strategic approaches to succeed in the start-up 5. Assess the progress of a new business venture and promote sustainability												
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	3	2	3	2	2	3	2	2	3	2	3
CO-2	3	2	1	2	3	3	2	1	3	3	2	3	3	3
CO-3	2	3	2	3	2	3	2	1	2	2	2	3	2	1
CO-4	3	3	2	2	2	2	1	2	3	3	2	3	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: ENTREPRENEURIAL COMPETENCE												(6L)		
Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur. Suggested Readings: 1. Knowledge and Skills of Entrepreneur												CO-1 BTL-3		
MODULE 2: ENTREPRENEURIAL ENVIRONMENT												(6L)		
Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services - Central and State Government Industrial Policies and Regulations - International Business. Suggested Readings: 1. Central and State Government Industrial Policies												CO-2 BTL-3		
MODULE 3: BUSINESS PLAN PREPARATION												(6L)		

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria. Suggested Readings: 1. Criteria for Selection of Product	CO-3 BTL-3
MODULE 4: LAUNCHING OF NEWVENTURE (6L)	
Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, IT startups. Suggested Readings:	CO-4 BTL-3
MODULE 5: MANAGEMENT OF NEW VENTURE (6L)	
Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business. Suggested Readings: 1. Monitoring and Evaluation of Business	CO-5 BTL-3
BOOKS	
1.	Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
2.	S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001
REFERENCE BOOKS	
1	Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra ,2nd Edition ,2005
2	Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.
3	P. Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai -1997.
4	Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning.2012
E Resources for Reference	
1.	https://epgp.inflibnet.ac.in/ahl.php?csrno=23 (Management P-01, M-02)
2.	https://epgp.inflibnet.ac.in/ahl.php?csrno=23 (Management P-01, M-13)
3.	https://epgp.inflibnet.ac.in/ahl.php?csrno=23 (Management P-01, M-14)
4.	https://epgp.inflibnet.ac.in/ahl.php?csrno=23 (Management P-01, M-21)
5.	https://epgp.inflibnet.ac.in/ahl.php?csrno=23 (Management P-01, M-30)
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc21_mg70/preview
2.	https://onlinecourses.nptel.ac.in/noc22_ge03/preview

COURSE TITLE		PROBLEM SOLVING USING QUANTITATIVE TECHNIQUES			CREDITS	1
COURSE CODE	ETP51855	COURSE	HS	L-T-P-S	1 - 0 - 2 - 2	
Version	1.0	Approval Details	41ACM Dt. 13 Jul 24	LEARNING LEVEL	BTL - 3	
CIA					ESE	
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%

Course Description	This course is designed to develop and enhance students' quantitative aptitude and verbal reasoning skills, essential for competitive exams, academic pursuits, and professional success. The quantitative aptitude section covers fundamental mathematical concepts, problem-solving techniques, and data interpretation. The verbal reasoning section focuses on critical thinking, comprehension, and effective communication. Through a combination of theoretical knowledge and practical exercises, students will gain the confidence and proficiency required to tackle various aptitude tests.													
Course Objective	1. To provide a thorough grounding in basic mathematical concepts and principles essential for quantitative aptitude. 2. To enhance students' ability to solve a variety of quantitative problems efficiently and accurately. 3. To develop skills in interpreting and analyzing data presented in various formats such as charts, graphs, and tables. 4. To cultivate critical thinking and logical reasoning abilities necessary for verbal reasoning tasks. 5. To develop proficiency in solving various types of puzzles and logical reasoning problems.													
Course Outcome	At the end of the course the students will be able to: 1. Demonstrate a solid understanding of fundamental mathematical concepts and their applications. 2. Solve quantitative problems with accuracy and speed. 3. Interpret data from various sources and making informed decisions based on that data. 4. Exhibit strong critical thinking and logical reasoning skills required for verbal reasoning tasks. 5. Solve puzzles and logical reasoning problems.													
Prerequisites: Plus Two -Intermediate Level														
CO AND PO MAPPING														
CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO-1	-	-	-	-	-	-	-	-	-		3		-	-
CO-2	-	-	-	-	-	-	-	2	2		3		-	-
CO-3	-	-	-	-	-	-	-	-	-		3		-	-
CO-4	-	-	-	-	-	-	2	-	-		3		2	-
CO-5	-	-	-	-	-	-	-	-	2		3		2	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Number System												(3L + 6P)		
Number System, Problems with HCF and LCM - Divisibility Rules – Progression: AP, GP & HP – Mean & Averages- Allegations & Mixtures – Percentages - Maths using BODMAS Rule												CO-1		
												BTL-2		
MODULE 2: Profit & Loss												(3L + 6P)		
Profit & Loss - Interest: Simple Interest & Compound Interest – Ratio, Proportion & Variation - Time & Work – Time, Speed & Distance - Problems on Trains- Trigonometry												CO-2		
												BTL-3		
MODULE 3 : Logarithms												(3L + 6P)		

Logarithms - Permutations & Combinations– Probability - Surds & Indices - Decimal Fractions - Spatial Ability - Functions – Graphs - Data Interpretation on Multiple Charts		CO-3 BTL-3
MODULE 4 : Quadratic Equations		(3L + 6P)
Quadratic Equations- Set Theory- Conditional Syllogisms - Statements and Conclusions - Statements and Assumptions- Geometry-Mensuration – Pipes & Cisterns - Sequence – Series		CO-4 BTL-3
MODULE 5 : Inequalities		(3L + 6P)
Inequalities- Image Based Problems- Clocks & Calendars - Problems on Ages - Factor Theorem - Power Theorem - Remainder Theorem -Coordinate Geometry		CO-5 BTL-3
TEXT-BOOK		
1	Sharma, Arun (2022). <i>Quantitative Aptitude for Competitive Examinations (11th Ed)</i> . New Delhi: McGraw Hill.	
REFERENCE BOOK		
1.	Agarwal, RS (2022). <i>How to Prepare for Quantitative Aptitude</i> . New Delhi: S Chand.	

COURSE TITLE	INTERNSHIP – 2 (To be evaluated in 5 th semester. To be carried out in summer after 4 th semester)				CREDITS	1								
COURSE CODE	EAT51804	COURSE CATEGORY	EEC	L-T-P-S	0-0-0-0									
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-4									
ASSESSMENT SCHEME														
Visit Report, Feedback of the employer, Presentation & Viva Voce, MCQ Assessment														
100%														
Course Description	This course aims to inculcate the application of knowledge & skill learned through classroom practices. It demands the academic component consisting of research, reflection, written and oral skills of the learner.													
Course Objective	The course will enable the students to 1. Explore career alternatives prior to graduation. 2. Integrate theory and practice. 3. Assess interests and abilities in their field of study. 4. Build a record of work experience.													
Course Outcome	Upon completion of this course, the students will be able to 1. Choose appropriate modern tools used in the field of Electronics and Communication engineering to manage the resources effectively by applying innovative ideas 2. Demonstrate ethical conduct and professional accountability while working in a team for the benefit of society. 3. Communicate effectively and to write the scientific report of the learnings													
Prerequisites: Basic knowledge in Measurements, Data Analysis, Interpretation.														
CO, PO AND PSO MAPPING														
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PS O-2
CO-1	2	2	3	3	2	2	1	2	-	-	2	-	1	3
CO-2	2	2	3	3	2	-	1	2	2	2	-	-	2	1
CO-3	2	2	3	3	2	-	1	2	3	3	3	2	1	1

Weightage of Assessment:

Assessment Scheme	Weightage
Presentation & Viva voce	50 %
Report	20 %
Feedback of the Employer	30%

A committee will be constituted by the HoD with Internship coordinator as head for learning assessment

process

Assessment Rubrics

Performance Indicators	Excellent(5)	Good(4)	Fair(3)	Poor(2)
Requirement analysis and clarity on problem statement(5)	Requirement well understood and problem statement well defined	Requirement well understood but problem statement not well defined	Understood the requirement and not defined properly	Not properly understood the requirements and problem statement not defined properly
Relevance with Industry /Societal problem(5)	Relevant	Relevant to industry with small modifications	Partially relevant	Irrelevant
Project timeline scheduled(5)	Scheduled and followed strictly	Scheduled and but not followed strictly	Scheduled but not followed	Not Scheduled and not followed
Usage of latest application and software(5)	latest applications and software's are used	Moderate usage of new technology	Slightly outdated	No latest applications and software's used
Design and code efficiency(5)	Excellent design of experiment and all possible outcomes are handled	Effective design but all possible outcomes are not handled	Satisfactory Design	Irrelevant design
Report Preparation(10)	Excellent documentation	Good documentation	Average documentation	Poor documentation
Presentation skills ,Fluency and comprehensibility(5)	Excellent communication skills and good comprehensibility	Good confidence , lack of communication skills and average comprehensibility	Less confidence, vocabulary need to be improved and poor comprehensibility	Poor skills
Slide organization and contents time conscious(5)	Content is organized properly and effective time management	Content is organized properly but not effective time management	Content is not organized properly	Poor organization and least time management
Feedback from Industry mentor(5)	Regular /novel idea/Excellent execution of project	Regular /Novel idea/Good execution of project	Regular /existing idea/Good execution of project	Irregular /existing idea/Poor execution of project

SEMESTER-VI

COURSE TITLE	VEHICLE DYNAMICS			CREDITS	4
COURSE CODE	EAT51011	COURSE CATEGORY	PC	L-T-P-S	2-1-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA				ESE	

First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical								
15%	15%	10%	5%	5%	25%	25%								
Course Description	Vehicle dynamics is a course that helps to study the performance related to the dynamics of all the parts of a vehicle. This course covers concept about the design of the vehicle's tires and its functions, ideas about suspension functions, also it covers the static and dynamic performance of a vehicle at various road and speed conditions.													
Course Objective	1. To discuss vibrating systems and its analysis, modeling, simulation and modal analysis. 2. To apply various Suspension systems, selection of springs and dampers. 3. To interpret the stability of vehicles on curved track and slope, gyroscopic effects and cross wind handling. 4. To discuss tyres, ride characteristics and effect of camber, camber thrust. 5. To develop vehicle handling under different steering conditions and directional stability of vehicles.													
Course Outcome	Upon completion of this course, the students will be able to 1. Discuss on vibration effects in vehicles and how to handle it properly. 2. Apply the principles and types of suspension and the new technologies needed to maximize its effectiveness. 3. Apply the concept of stability of vehicles on curved track and slope, gyroscopic effects and cross wind handling. 4. Analyze the ride characteristics and effect of camber, camber thrust. 5. Develop vehicle handling concepts under different steering conditions and directional stability of vehicles.													
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	3	2	3	2	-	3	-	-	-	-	3	2	1
CO-2	3	2	3	2	3	-	2	-	-	-	-	2	1	2
CO-3	2	3	2	3	2	-	2	-	-	-	-	3	2	1
CO-4	3	2	3	2	3	-	3	-	-	-	-	2	1	2
CO-5	3	3	3	3	3	-	2	-	-	-	-	3	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: INTRODUCTION												(6L+ 3T+6P)		
Classification of vibration, definitions, mechanical vibrating systems, vibration and human comfort. Free, forced and damped vibrations - Magnification and Transmissibility. Vibration absorber. Model of an automobile, one degree of freedom, two degree of freedom systems - Multi-degree of Freedom Systems. Lab Experiments 1.Testing of natural frequency Software/Equipment Required 1. Measuring Devices – Displacement, Velocity and acceleration												CO-1 BTL-3		
MODULE 2: SUSPENSION												(6L+ 3T+6P)		
Requirements. Spring mass frequency. Wheel hop, wheel wobble, wheel shimmy, Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft												CO-2 BTL-3		

directions. Hydraulic dampers and choice of damper characteristics. Independent, compensated, rubber and air suspension systems. Roll axis and vehicle under the action of side forces. Lab Experiments 1. Measurement of displacement, velocity and acceleration 2. Whirling of Shafts- to determine critical speed Software/Equipment Required 1. Whirling of shaft		
MODULE 3: STABILITY OF VEHICLES		(6L+ 3T+6P)
Load distribution. Stability on a curved track and on a slope. Gyroscopic effects, weight transfer during acceleration and braking, over turning and sliding. Rigid vehicle – stability and equations of motion. Cross wind handling. Lab Experiments 1. Camber angle measurement Software/Equipment Required 1. Camber angle measuring device		CO-3 BTL-3
MODULE 4: TYRES		(6L+ 3T+6P)
Types. Relative merits and demerits. Ride characteristics. Behaviour while cornering, slip angle, cornering force, power consumed by a tyre. Effect of camber, camber thrust. Lab Experiments 1. Introduction to MAT Lab – Simulink, solving simple MCK problems Software/Equipment Required 1. MAT Lab – Simulink		CO-4 BTL-3
MODULE 5: VEHICLE HANDLING		(6L+ 3T+6P)
Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering. Effect of camber, transient effects in cornering. Directional stability of vehicles. Lab Experiments 1. Modal Analysis of given structure Software/Equipment Required 1. LS Dyna / Adams		CO-5 BTL-3
TEXT TEXT BOOKS		
1.	Thomas D. Gillespie, “Fundamentals of vehicle dynamics”,2012	
2.	J. Y. Wong, ‘Theory of Ground Vehicles’, John Wiley and Sons Inc., New York, 2013	
REFERENCE BOOKS		
1	Hans Pacejka, Tire and Vehicle Dynamics, Elsevier, 2012.	
2	Garrett T K, Newton K and Steeds W, “Motor Vehicle”, ButterWorths & Co., Publishers Ltd., New Delhi, 2001.	
E Resources for Reference		
1.	The Motor Vehicle, Automobile engineering, Authors: T. K. Garrett, Kenneth Newton, William Steeds Publisher: Butterworth-Heinemann, 2001 ISBN 0750644494, 9780750644495	
2.	Theory of Ground Vehicles, Fifth Edition. By J. Y. Wong · 2022; ISBN:9781119719700, 1119719704 Page count:600; Published:19 April 2022; Format: Hardback Publisher: Wiley; Language: English; Author: J. Y. Wong	

MOOC	
1.	http://nptel.ac.in/courses/107106080/
2.	https://www.mooc-list.com/course/vehicle-dynamics-ii-cornering-iversity

COURSE TITLE		Design and Simulation of Electric and Hybrid Vehicles				CREDITS		3						
COURSE CODE		EAT51012		COURSE CATEGORY		PC		L-T-P-S		2-0-2-2				
VERSION		1.0		APPROVAL DETAILS		36 th ACM		LEARNING LEVEL		BTL-4				
ASSESSMENT SCHEME														
CIA										ESE				
First Periodical Assessment (Theory)		Second Periodical Assessment (Theory)		Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		Theory		Practical		
15%		15%		10%		5%		5%		25%		25%		
Course Description		The course provides a detailed information about design and simulation of various components of electric and hybrid vehicles. Torque and Energy Consumption of Electric and Hybrid Vehicle (EHV) will be educated to the learners. Design of Energy storage and management systems were taught to the students. Finally course also provide detailed insights about design of controllers and safety systems of EHV												
Course Objectives		1. Students should calculate total torque and energy required to propel an EHV 2. Students should Design and Simulate an Energy Storage System for an EHV 3. Students should analyze the Design procedure of Energy Management System of an EHV 4. Students should evaluate the Design Procedure of Various Controllers and Safety Systems of an EHV 5. Students should explain the design procedure of Charing Station of an EHV.												
Course Outcomes		Upon completion of this course, the students will be able to 1. Calculate total torque and energy required to propel an EHV 2. Design and Simulate an Energy Storage System for an EHV 3. Analyze the Design procedure of Energy Management System for an EHV 4. Evaluate the Design Procedure of Various Controllers and Safety Systems for an EHV 5. Explain the design procedure of Charing Station for an EHV.												
Prerequisites: Two and Three-wheeler EV Technology														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	3	2	3	2	2	1	2	1	1	3	3	3
CO-2	3	3	3	2	3	2	2	1	2	1	1	3	3	3
CO-3	3	3	3	2	3	2	2	1	2	1	1	3	3	3
CO-4	3	3	3	2	3	2	2	1	2	1	1	3	3	3
CO-5	3	3	3	2	3	2	2	1	2	1	1	3	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Motor Torque Calculations for Electric Vehicle													(10L+5P)	
Types of Resistance – Calculation – Total Tractive Force – Torque Calculation – Energy Consumption - Selection and sizing of Motor - Component sizing – Locations - Mechanical and Electrical connections													CO-1	
Lab Component: Simulation of Electric Motor & Generator													BTL-4	

Software: MATLAB		
Module 2 – Design of Energy Storage Solutions		(10L+5P)
Cell Types - Charging and Discharging calculation - Cell Selection and sizing - Battery layout - Battery Pack Configuration and Construction - Selection criteria. Lab Component : Simulation of Energy Storage System Software: MATLAB		CO-2 BTL-4
Module 3 – Design of Energy Management System		(10L+5P)
Energy Management System - Rule based control and optimization-based control - Software-based high level supervisory control - Mode of power - Behavior of motor - Advance Features Lab Component: Simulation of Energy Management System Software: MATLAB		CO-3 BTL-4
Module 4 – Design of Controllers and Safety Systems		(10L+5P)
Controllers – Classification – Development Process – Software - Hardware - Data Management – User Interface – Cyber Security – Safety System Lab Component: Simulation of Controllers and Safety Systems Software: MATLAB		CO-4 BTL-4
Module 5 – Design of Charing Station		(10L+5P)
Charing Station – Layout - Types – Infrastructure - Selection and Sizing of charging station – Safety Systems. Lab Component : Simulation of Various Components of Charging Station Software: MATLAB		CO-5 BTL-4
TEXT BOOKS		
1.	Amir Khajepour, Saber Fallah and AvestaGoodarzi, “Electric and Hybrid Vehicles Technologies, Modelling and Control: A Mechatronic Approach”, John Wiley & Sons Ltd, 2014.	
2.	Antoni Szumanowski, “Hybrid Electric Power Train Engineering and Technology: Modelling, Control, and Simulation”, IGI Global, 2013.	
REFERENCE BOOKS		
	Emadi, A. (Ed.), Miller, J., Ehsani, M., “Vehicular Electric Power Systems” Boca Raton, CRC Press, 2003	
	Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013	
	Ibrahim Dinçer, Halil S. Hamut and Nader Javani, “Thermal Management of Electric Vehicle Battery Systems”, JohnWiley& Sons Ltd., 2016	
	Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles_ Fundamentals, Theory, and Design, Second Edition”, CRC Press, 2010	
E BOOKS		
1.	https://www.academia.edu/35166844/Basics of Electric Vehicles Design and Function	
2.	https://www.researchgate.net/publication/297751735 Electric vehicle design modelling and optimization/link/59fc1835458515d070628374/download	

MOOC	
1.	https://www.coursera.org/certificates/power-electronics-motors-ev-iitbombay
2	https://onlinecourses.nptel.ac.in/noc21_ee112/preview

COURSE TITLE	CONTROL SYSTEM FOR AUTOMOTIVE APPLICATIONS			CREDITS	3								
COURSE CODE	EAT51013	COURSE CATEGORY	PC	L-T-P-S	2-0-2-2								
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-4								
ASSESSMENT SCHEME													
CIA					ESE								
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical							
15%	15%	10%	5%	5%	25%	25%							
Course Description	This course gives a strong theoretical foundation for understanding open loop and closed loop control system analysis and is suitable for general engineering students. It covers standard analytical tools such as Bode plot, Polar plot, root-loci and nyquist plots. Later part of the module focuses on formation of state space equation and analysis of observability and controllability.												
Course Objective	1. To familiarize the students with the modeling of electromechanical system and the characteristics of control components 2. To provide knowledge on Feedback control and stability analysis in Time and frequency domains. 3. To develop a specific technical expertise in the analysis and design of Feedback Control Systems. 4. To familiarize with the modeling of dynamical systems, to simulate and analyze the stability of the system using MATLAB.												
Course Outcome	Upon completion of this course, the students will be able to 1. Analyze electromechanical systems using mathematical modelling and to build transfer function 2. Determine Transient and Steady State behavior of systems using standard test signals and compute Steady state error 3. Analyze the stability of the system using frequency response plots 4. Analyze the stability of the system by applying various stability criteria. 5. Model state space equation in various forms and analyze the observability and controllability of the system.												
CO, PO AND PSO MAPPING													
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO
CO-1	3	3	-	3	1	-	-	-	-	-	-	-	
CO-2	3	3	3	-	-	-	-	-	-		-	1	
CO-3	3	3	3	2	2	-	-	-	-	-	-	2	
CO-4	3	3	3	2	2	-	-	-	-	-	-	2	
CO-5	3	3	3	3	1	-	-	-	-	-	-	1	
1: Weakly related, 2: Moderately related and 3: Strongly related													

MODULE 1: SYSTEMS AND THEIR REPRESENTATION (6L+ 6P)	
Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs. Suggested Readings: Transfer function of field controlled and armature controlled DC motor Lab Experiments 1. Transfer function of AC Servomotor 2. Study of Synchros Software/Equipment Required 1. Two Phase AC Servomotor Kit 2. Synchro Transmitter and Receiver Pair	CO-1 BTL-4
MODULE 2: TIME RESPONSE ANALYSIS (6L+ 6P)	
Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control. Suggested Readings: PID based speed control of DC motor Lab Experiments 1. Analog Simulation of Type-0 and Type-1 system 2. Design of P, PI and PID controllers 3. Determination of time domain specifications using MATLAB Software/Equipment Required 1. Process Control Simulator Kit 2. MATLAB Software	CO-2 BTL-3
MODULE 3: FREQUENCY RESPONSE ANALYSIS (6L+ 6P)	
Frequency response – Bode plot – Polar plot - Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications. Suggested Readings: 1. Improvement of Steering Response Development Using Bode Plot 2. Frequency Response Analysis using Lead, Lag and Lead-Lag Compensator Lab Experiments 1. Frequency response analysis using Bode Plot and Polar Plot using MATLAB 2. Frequency Response Analysis using Lead, Lag and Lead-Lag Compensator Software/Equipment Required 1. MATLAB Software 2. Lead-Lag Compensator Network Kit	CO-3 BTL-4
MODULE 4: STABILITY OF CONTROL SYSTEM (6L+ 6P)	
Characteristics equation – Location of roots in S plane for stability – Routh-Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion. Suggested Readings: Root locus approach in design of PID controller for cruise control application Lab Experiments 1. Response of first and second order system using MATLAB 2. Stability analysis of linear system using MATLAB Software/Equipment Required MATLAB Software	CO-4 BTL-4
MODULE 5: STATE SPACE ANALYSIS (6L+ 6P)	
Introduction to State Space Analysis – Phase variable and Canonical Forms – State Transition Matrix – Solutions to state space equation – Discretization of state space equation, controllability and observability of systems. Suggested Readings: State space modeling of DC Motor using MATLAB Lab Experiments 1. Digital Simulation of linear system using MATLAB/Simulink 2. Digital Simulation of non-linear system using MATLAB/Simulink 3. State space representation of a system using MATLAB	CO-5 BTL-4

Software/Equipment Required MATLAB Software	
BOOKS	
1.	K. Ogata, "Modern Control Engineering", 5th edition, Pearson Education, New Delhi, 2017.
2.	I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2018.
3.	Ashish Tewari, "Modern Control Design with Matlab-Simulink", John Wiley, & Sons, New Delhi 2015.
REFERENCE BOOKS	
1	B.C. Kuo, "Automatic Control Systems", Prentice Hall of India Ltd., New Delhi, 2015.
2	M. Gopal, "Control Systems, Principles & Design", Tata McGraw Hill, New Delhi, 2017.
3	M.N. Bandyopadhyay, "Control Engineering Theory and Practice", Prentice Hall of India, 2016.
4	M. Gopal, "Modern Control System Theory", New Age International Publishers, 2015.
E Resources for Reference	
1.	https://easyengineering.net/control-systems-engineering-by-nagrath-nw/
2.	http://docs.znu.ac.ir/members/pirmohamadi_ali/Control/Katsuhiko%20Ogata%20_%20Modern%20Control%20Engineering%205th%20Edition.pdf
3.	https://pdfcoffee.com/control-systems-by-anand-kumar-pdf-free.html
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc19_de04/preview
2.	https://onlinecourses.nptel.ac.in/noc22_ee31/preview
3.	https://onlinecourses.nptel.ac.in/noc20_me25/preview
4.	https://onlinecourses.nptel.ac.in/noc21_ee70/preview
5.	http://nptel.ac.in/courses/108103007/

COURSE TITLE	INTRODUCTION TO INDUSTRY 4.0			CREDITS	3
COURSE CODE	EAT51014	COURSE CATEGORY	PC	L-T-P-S	2-0-2-6
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	Theory Practical
15%	15%	10%	5%	5%	25% 25%
Course Description	Industry 4.0, also known as the fourth industrial revolution, represents a significant advancement in digital technology compared to previous decades. It elevates the role of connectivity through the Internet of Things (IoT), real-time data accessibility and the integration of cyber-physical systems. Industry 4.0 introduces a more comprehensive and interconnected approach to manufacturing, bridging the physical and digital realms. This facilitates improved collaboration and accessibility across various aspects such as departments, partners, vendors, products and individuals. The course provides an overview of the major trends and fundamental concepts of Industry 4.0, highlighting its relevance for development. It also offers a detailed explanation of emerging technologies and their impact.				
Course Objective	The course should enable the students to				

	1. Explore the fundamental concept in Industry 4.0 for various applications. 2. Gain knowledge on the concept of sensors, communication and networking protocol applied in industries. 3. Outline the use of analytics and data management in industrial IoT 4. Enumerate the application of computing in IoT security 5. Develop solution for Real time problems and analyze case studies related to industrial IoT														
Course Outcome	Upon completion of this course, the students will be able to 1. Comprehend the basic concepts involved in industry 4.0 2. Infer knowledge in the basics of sensors, communication and networks commercialized in industries. 3. Paraphrase the importance of Big Data analytics and data management in industrial IoT 4. Summarize the application of computing in IoT security 5. Illustrate the applications of Industrial IoT with real-time case studies.														
Prerequisites: Basic knowledge of computer network and internet															
CO, PO AND PSO MAPPING															
CO	P O- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO -1	PSO -2	
CO-1	3	3	3	3	2	-	1	-	2	3	3	-	2	2	
CO-2	3	3	3	3	2	-	1	-	2	3	3	2	2	2	
CO-3	3	3	3	3	2	-	1	-	2	3	3	-	2	2	
CO-4	3	3	3	3	2	-	1	-	2	3	3	-	2	2	
CO-5	3	3	3	3	2	-	1	-	2	3	3	2	2	2	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO INDUSTRY 4.0 (6L+ 6P)															
The Fourth Revolution, Globalization and Emerging Issues, LEAN Production Systems, Introduction: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence Suggested Readings: Comparison of Industry 4.0 Factory and Today's Factory Lab Experiments 1. Introduction to Arduino 2. Introduction to raspberry Pi Software/Equipment Required Arduino, Raspberry Pi													CO-1 BTL-3		
MODULE 2: INDUSTRIAL IoT (6L+ 6P)															
IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture, Topology, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking, Suggested Readings: Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 Lab Experiments 1. Interfacing Arduino to Zigbee module 2. Interfacing Arduino to Bluetooth module Software/Equipment Required Arduino, Zigbee, Bluetooth													CO-2 BTL-3		

MODULE 3: BIG DATA AND IIoT ANALYTICS		(6L+ 6P)
Big Data, Characteristics and types of Big Data, Analysing of Data, Applications, Big Data tools, Introduction to Machine Learning and Data Science, R and Julia Programming, IIOT Analytics, Role of Analytics in IIOT, Data visualization Techniques. Suggested Readings Software Defined Networking Lab Experiments 1. Measurement of temperature values of the process 2. Measurement of pressure values of the process Software/Equipment Required Arduino/Raspberry pi/Node mcu		CO-3 BTL-3
MODULE 4: IIoT SECURITY		(6L+ 6P)
Industrial IoT: Security, Cloud Computing in IIoT, Fog Computing in IIoT Suggested Readings: Data Management using Hadoop Lab Experiments Modules and Sensors / Actuators Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor, Relay, Motor, Buzzer) Software/Equipment Required Raspberry pi/node mcu, Relay, Motor, Buzzer, Sensors		CO-4 BTL-3
MODULE 5: APPLICATIONS AND CASE STUDIES		(6L+ 6P)
Industrial IoT- Application Domains: Automobile, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Smart Home, Smart Farm and Smart Car Suggested Readings: Automobile Manufacturing Industries Lab Experiments Smart home applications Software/Equipment Required Embedded PC based development boards		CO-5 BTL-3
TEXT BOOKS		
1.	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016.	
2.	Ismail Butun, "Industrial IoT : Challenges, Design Principles, Applications, and Security", first edition, Springer, 2020.	
REFERENCE BOOKS		
1.	Christoph Jan Bartodziej, "The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics", Springer, 2017.	
2.	Rajkamal, "Embedded System: Architecture, Programming and Design", 3rd edition, McGraw Hill Education, 2017.	
E RESOURCES FOR REFERENCE		
1.	https://www.pdfdrive.com/industry-40-industrial-revolution-of-the-21st-century-e187573163.html	
2.	https://download.e-bookshelf.de/download/0007/6832/86/L-G-0007683286-0014731014.pdf	
MOOC		
1.	https://onlinecourses.nptel.ac.in/noc20_cs24/preview	
2.	https://www.coursera.org/learn/industrial-internet-of-things?	

COURSE TITLE		DESIGN PROJECT-4										CREDITS		1	
COURSE CODE		EAT51805			COURSE CATEGORY				EEC			L-T-P-S		0-0-2-6	
Version		1.0			Approval Details				36 th ACM			LEARNING LEVEL		BTL-5	
ASSESSMENT SCHEME															
First Review		Second Review				Third Review				Project Report & Viva Voce					
20%		20%				10%				50%					
Course Description		This course provides the student significant design experience with the knowledge and skills required to analyse the real time problem statement and gives a strong Engineering and Practical foundation for understanding the different types of social problems and its solution based on engineering knowledge. This course suitable for general engineering students to understand the importance of engineering concepts and its relevant applications. Different Simulation tools to be used in the execution of the design methodology. The resources and team management skills are utilised to develop an innovative, economic solution to the selected problem.													
Course Objective		The course will enable the students to: 1. Demonstrate a wide range of the skills learned during their course of study by delivering a product that has passed through the design, analysis, testing and evaluation. 2. Encourage multidisciplinary research by integrating the concepts learned in a various courses. 3. Develop problem solving, analysis, synthesis and evaluation skills and communication skills by emphasizing them to prepare project report, poster and oral presentation.													
Course Outcome		Upon completion of this course, the students will be able to 1. Identify and work for the real life needs of the society 2. Implement practical solutions to the societal problem 3. Demonstrate the importance of Engineering concepts and its relevant application													
Prerequisites: Design Project-3															
CO, PO AND PSO MAPPING															
	PO-1	PO-2	PO - 3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2	
CO-1	3	3	2	2	3	2	2	3	3	3	3	1	1	2	
CO-2	3	3	3	2	3	2	2	3	3	3	3	1	2	1	
CO-3	3	3	3	2	3	2	2	3	3	3	3	1	2	2	

Weightage of Assessment:

Review / Examination Scheme	Weightage
First Review	20%
Second Review	20%
Third Review	10%

End Semester Viva Voce	50%
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A committee shall be constituted by the HoD for the Review.

Assessment Rubrics

Parameter	Weightage (%)
Title & Objectives	5.0
Review of Literature (RL)	10.0
Design / Implementation	10.0
Methodology	5.0
Planning of Project Work	5.0
Testing Environment / Test Cases	5.0
Analytical thinking*	5.0
Technical Knowledge*	5.0
Presentation*	10.0
Demonstration*	5.0
Individual Roles Distribution* (Individual Objectives in the project work)	5.0
Individual Contributions* (Towards the individual objectives in the project work)	5.0
Deliverables	5.0
Team- work	10.0
Report / Thesis	5.0
Peer Assessment*	5.0

* - Attributes for individual contribution.

COURSE	PROFESSIONAL SKILL AND ETHICS			CREDITS	Non Credit	
COURSE CODE	ETP51854	COURSE CATEGORY	MC	L - T - P - S	0-0-3-2	
Version	1.0	Approval Details	41ACM Dt. 13 Jul 24	LEARNING LEVEL	BTL – 3	
CIA					ESE	
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%

Course Description	The Grooming and Mock Interview Training course is a focused 10-hour program designed to prepare the students for successful campus placements and professional careers. This course covers essential aspects of personal grooming, professional etiquette, effective communication, resume building, and interview preparation. Through practical exercises, interactive sessions, and real-world scenarios, students will gain the skills and confidence needed to excel in job interviews and professional environments.														
Course Objective	1. To enhance personal grooming and professional etiquette. 2. To improve verbal and non-verbal communication skills. 3. To create customised resumes and cover letters as per job role. 4. To prepare students for various types of interviews. 5. To provide practical experience through mock interviews and group discussions.														
Course Outcome	Upon completion of this course, the students will be able to 6. Exhibit appropriate personal grooming and professional attire suitable for various business environments. 7. Communicate effectively and confidently in verbal and non-verbal interactions, ensuring clarity, articulation, and appropriate tone. 8. Formulate well-structured, targeted resumes and cover letter that highlight relevant skills, achievements, and experiences. 9. Prepare for different types of interviews (HR and Technical), knowing what each assesses. 10. Engage confidently in mock interviews, receiving and incorporating feedback to improve performance.														
Prerequisites: Plus Two English-Intermediate Level															
CO, PO AND PSO MAPPING															
CO/PO	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PO ₉	PO ₁₀	PO ₁₁	PO ₁₂	PSO ₁	PSO ₂	
CO1	-	-	-	-	-	-	-	2	1	2	-	3	1	1	
CO2	-	-	-	-	-	-	-	2	2	2	-	3	0	1	
CO3	-	-	-	-	-	-	-	2	2	2	-	3	1	1	
CO4	-	-	-	-	-	-	-	-	1	2	2	3	1	1	
CO5	-	-	-	-	-	-	-	-	2	2	2	3	1	1	
1: Weakly related, 2: Moderately related and 3: Strongly related															
Module 1 : BUSINESS ETHICS AND ETIQUETTE															(9P)
Importance of personal grooming-Dressing for success: Business formal and business casual attire- Personal hygiene and grooming tips- Makeup and accessories for a professional look- Introduction to professional behavior-Business etiquettes: Do's and don'ts-Practice for professional dressing, Dining Etiquettes															CO-1 BTL-2
Module 2 : TAILORING AND CUSTOMIZING RESUME TO MEET JOB ROLE INCLUDING COVER LETTER (9P)															
Key components of a professional resume- Tailoring your resume for different job profiles- Use of Action verbs in Resume-Resume do's and don'ts- Reviewing and refining student resumes as per job description- Customizing cover letters for specific roles, Preparation of Checklist and Portfolio, Researching for the company and gaining details of the job description															CO-2 BTL-3
Module 3: VERBAL AND NON-VERBAL PRESENTATION IN THE INTERVIEW															(9P)
Effective speaking skills-Articulation and clarity-Tone and pitch control- Introducing oneself in a professional setting- Making first impression- Non-Verbal Communication: Importance of body															CO-3 BTL-3

language-Eye contact, facial expressions, and gestures- Posture and handshake- Magics of smile in interview-Role-playing exercises to enhance non-verbal cues- Time management in interviews		
Module 4: INTERVIEW PREPARATION TECHNIQUES		(9P)
Overview of different types of interviews: HR and Technical-Understanding what each type of interview assesses- Discussing frequently asked interview questions- STAR method for answering behavioural questions (Situation, Task, Action, Result)- Practice for answering common questions in pairs, Removing Fear, nervousness and anxiety using relaxation method and breathing techniques		CO-4 BTL-3
Module 5 : MOCK INTERVIEWS AS PER JOB ROLE AND FEEDBACK		(9P)
Simulated one-on-one interviews as per job description with feedback-Role-playing in different interview scenarios (HR, Technical)- Time management in responses-Feedback to Each Student regarding merits and scopes for improvement, Advanced strategies for handling difficult interview questions, Negotiation skills and salary discussions, Interaction with Alumni Ambassadors-Full length Panel Interview Follow-Up Emails and Letters- Maintaining Professional Connections and networking		CO-5 BTL-3
TEXT BOOK		
1	Collins, Allan (2016). HR Interview Secrets: How to Ace Your Next Human Resources Interview, Dazzle Your Interviewers & LAND THE JOB YOU WANT! USA: Success in hr.	

Semester VII

COURSE TITLE		ENGLISH FOR COMPETITIVE EXAMINATIONS				CREDITS	1
COURSE CODE		GLS51006	COURSE CATEGORY		HS	L-T-P-S	0-0-2-1
VERSION	1	APPROVAL DETAILS		35 th ACM		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME							
CIA						ESE	
First Periodical Assessment	Second Periodical Assessment	Practical Assesment	Surprise Test / Quiz., as approved by the Department Examination Committee “DEC”		Attendance	Practical	Theory
15 %	15 %	10 %	5 %		5 %	25 %	25 %
Course Description	This course provides students with the skills and strategies needed to succeed in competitive exams, such as English grammar, vocabulary, reading and writing skills, listening comprehension, and critical thinking. It also helps them to understand the English language and exam structure better.						
Course Objective	1. To provide an environment where people may compete on both a formal and casual level and employ those abilities in regular conversation, presentations, group discussions, and debates. 2. To prepare the students to read literary materials, comprehend them, and respond to questions based on them. 3. Assisting students in developing social awareness and positive responses to societal demands. 4. To give students a setting in which to take competitive exams.						
Course Outcome	Upon completion of this course, the students will be able to; 1. Acquire knowledge of the structure and format of competitive examinations. 2. Improve vocabulary and grammar to increase success in competitive examinations. 3. Develop critical thinking and problem-solving skills to answer complex questions.						

	4. Analyse their vocabulary and communication ability to build the knowledge of idioms, phrasal verbs and commonly used expressions for better productivity, job performance and to develop self-confidence. 5. Learn how to approach and solve comprehension and essay questions with confidence.													
Prerequisites:-IntermediateLevel														
CO,PO AND PSO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-			-
CO2	-	-	-	-	-	-	-	2	2	3	-			-
CO3	-	-	-	-	-	-	-	-	-	3	-			-
CO4	-	-	-	-	-	-	2	-	-	3	2			-
CO5	-	-	-	-	-	-	-	-	2	3	2			3
1:Weaklyrelated,2:Moderatelyrelatedand3:Stronglyrelated														
MODULE 1													(6P)	
Introduction to Competitive Exams - IELTS, TOEFL etc., Precis writing – Types of Letter writing – Business Letters – Letters for employability													CO-1 BTL-2	
MODULE 2													(6P)	
Reading Comprehension- Cloze Test- Passage Completion-Practice Test – Listening Comprehension Exercise (Lab)													CO-2 BTL-3	
MODULE 3													(6P)	
Spotting Errors- Sentence Improvement-Practice Test													CO-3 BTL-3	
MODULE 4													(6P)	
Para Jumbles- Tracing Odd Sentences- Synonyms and Antonyms-Practice Test													CO-4 BTL-3	
MODULE 5													(6P)	
Idioms and Phrases, One Word Substitution, Active and Passive Voice, Direct-Indirect Speech-Practice Tests													CO-5 BTL-3	
TEXT-BOOK														
1.	General English for Competitive Exams, by Dr. Rashmi Singh, 2 nd Edition													
REFERENCEBOOKS														
1.	TOEFL													
E-REFERENCES														
1	https://www.careers360.com/all-ebooks													
2	https://www.dishapublication.com/ebooks													
3	https://www.visionias.net/p/free-e-books-for-all-competitive.html													
4	https://www.fdaytalk.com/ebooks/													
MOOC														
1	https://www.mooc-list.com/tags/english													

COURSE TITLE	Fundamentals of Finite Element Analysis			CREDITS	4
COURSE CODE	EAT51015	COURSE CATEGORY	PC	L-T-P-S	2-1-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
CIA				ESE	

First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical								
15%	15%	10%	5%	5%	25%	25%								
Course Description	This course aims to make the students expert in solving the engineering structural, thermal and fluid flow problems with the help of finite element methods procedure. Also aims to provide knowledge on mathematical background in the FE analysis and provide hands-on training on analysis of engineering problems using FEA packages.													
Course Objectives	The course should enable the students to: 1. Identify the mathematical and physical principles underlying in finite element method 2. Apply the procedure of static structural analysis in 1D approach 3. Analyse the procedure of static structural analysis in 2D approach 4. Evaluate the procedure of dynamic analysis 5. Apply the Heat transfer and fluid flow problem in 1D and 2D approach													
Course Outcomes	Upon completion of this course, the students will be able to 1. Interpret the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis 2. Apply static structural analysis problems in 1D approach 3. Analyse static structural analysis in 2D approach 4. Derive and solve dynamic analysis structural problems 5. Solve the Heat transfer and fluid flow problem in 1D and 2D approach													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2
CO-1	3	3	1	3	3	1	1	-	-	-	1	3	3	3
CO-2	3	3	2	3	3	1	-	-	-	-	-	3	3	3
CO-3	3	3	3	3	3	2	1	-	-	-	-	3	3	3
CO-4	3	3	3	3	3	1	-	-	-	-	1	3	3	3
CO-5	3	3	3	3	3	1	1	-	-	-	1	3	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – INTRODUCTION												(6L+3T+6P)		
Engineering design analysis-meaning and purpose, steady state, propagation and transient problems. Concepts of FDM, FEM, FVM. Steps involved in FEM. Applicability of FEM to structural analysis, heat transfer and fluid flow problems. Advantages and limitations of FEM. Test for convergence. Element choice. Commercial finite element packages. Solution of Boundary value problem – Integral formulation for numerical solution - Variational methods - Minimum total potential energy formulation. Practical Experiments 1. Force and stress analysis of trusses 2. Stress and deflection analysis in various beam with different load types												CO-1 BTL-4		
Module 2 – ONE DIMENSIONAL FINITE ELEMENT ANALYSIS												(6L+3T+6P)		

Use of bar and beam elements in structural analysis. Bar Element – Stiffness matrix formulation by direct and polynomial methods. Boundary condition and assemblage concepts. Beam element characteristics matrix. Global, local, natural coordinates. Practical Experiments 1. Stress analysis of a rectangular plate with circular hole 2. Stress analysis of the corner angle bracket	CO-2 BTL-4
Module 3 – TWO DIMENSIONAL FINITE ELEMENT ANALYSIS	(6L+3T+6P)
Linear and quadratic Triangular elements - Rectangular elements - Quadratic quadrilateral elements - 2D elements applications for plane stress, plane strain and axis-symmetric problems. Treatment of boundary condition. Iso Parametric elements. Practical Experiments 1. Stress analysis of an axis-symmetric component 2. Stress and deflection analysis in various beam with different load types	CO-3 BTL-4
Module 4 – STRUCTURAL AND DYNAMIC ANALYSIS	(6L+3T+6P)
1D & 2D problems in Solid mechanics. Dynamics problems representation in FE. Free vibration problem formulation. Torsion of non-circular shaft - axisymmetric problem. Case Studies like Structural analysis of Chassis Frame, Whirling speed of propeller shaft, contact analysis of gears, modal analysis of suspension system, impact, crash worthiness etc. Practical Experiments 1. Thermal stress analysis within the rectangular plate 2. Convective heat transfer analysis of a 2D component	CO-4 BTL-4
Module 5 – HEAT TRANSFER AND FLUID FLOW ANALYSIS	(6L+3T+6P)
1D & 2D problems in fluid mechanics and heat transfer by conduction and convection. Transient thermal analysis. Case Studies like Heat transfer analysis of piston, fins. Practical Experiments 1. Modal analysis of various beam with different load types 2. Harmonic analysis of a 2D component 3. Simulation of spring-mass system using MAT LAB	CO-5 BTL-4
TEXT BOOKS	
1 J. N. Reddy, "Finite Element Methods", 2nd Edition, 6th Reprint, Tata McGraw Hill, 2015	
2 P. Seshu, "Text Book of Finite Element Analysis" 10 Reprint PHI Learning Pvt. Ltd. 2012	
REFERENCE BOOKS	
1 Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and applications of finite element analysis", 4th edition, John Wiley & Sons, 2017	
2 Krishnamurthy,C.S., Finite Element Analysis, Tata McGraw Hill. 2013	
E BOOKS	
1 https://www.mooc-list.com/tags/finite-element-method	
2 https://www.my-mooc.com/en/mooc/finite-element-method-fem-analysis-tsinghuax-70120073x-1/	
3 https://www.mooc-list.com/tags/finite-element-method	
MOOC	
1 https://www.mooc-list.com/tags/finite-element-method	
2 https://www.my-mooc.com/en/mooc/finite-element-method-fem-analysis-tsinghuax-70120073x-1/	

COURSE TITLE	VEHICLE DIAGNOSTICS AND MAINTENANCE				CREDITS	3								
COURSE CODE	EAT51016	COURSE CATEGORY	PC		L-T-P-S	2-0-2-2								
VERSION	1.0	APPROVAL DETAILS	36 th ACM		LEARNING LEVEL	BTL-3								
ASSESSMENT SCHEME														
CIA					ESE									
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance	Theory	Practical							
15%	15%	10%	5%		5%	25%	25%							
Course Description	The course aim is to impart practical and timely decision making in the vehicle maintenance workshop. Adapt the systematic procedure suggested by vehicle manufacturers in the Engine, Chassis and Electrical system and ancillary systems components maintenance..													
Course Objectives	1 Familiarize on vehicle maintenance procedures 2 Gain knowledge in maintenance procedures for various engine component 3. To demonstrate the procedure of chassis component maintenance systems 4. Acquire the knowledge in maintenance procedures for various Electrical component and accessories. 5. Instill the procedures for maintenance of fuel system, Cooling systems, Lubrication system and Vehicle Body													
Course Outcomes	Upon completion of this course, the students will be able to 1 Develop the vehicle maintenance procedures 2 Evaluate the maintenance procedures for various engine component 3 Identify the chassis component maintenance systems 4. Interpret maintenance procedures for various Electrical component and accessories. 5. Formulate the vehicle manual procedures for maintenance of fuel system, Cooling systems, Lubrication system and Vehicle Body													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	-	-	3	-	-	1	2	-	-	2	1	1
CO-2	3	3	-	-	3	-	-	1	2	-	-	2	1	2
CO-3	3	3	-	-	3	-	-	1	2	-	-	2	1	3
CO-4	3	3	-	-	3	-	-	1	2	-	-	2	1	2
CO-5	3	3	-	-	3	-	-	1	2	-	-	2	1	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
MODULE 1 - MAINTENANCE OF RECORDS AND SCHEDULES													(6L+6P)	
Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of checklists. Inspection schedule, Maintenance of records, log sheets and other forms, safety precautions in maintenance. Practical: Study the layout of automobile repair shop, tools and instruments.													CO-1 BTL-3	
MODULE 2 - ENGINE MAINTENANCE - REPAIR AND OVERHAULING													(6L+6P)	
Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up.													CO-2 BTL-3	

Practical: 1. Cylinder reboring.2. Valve grinding and valve lapping 3. Fault diagnosis of petrol and diesel fuel system and filters & air cleaners.		
MODULE 3 - CHASSIS MAINTENANCE - REPAIR AND OVERHAULING		(6L+6P)
Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft and differential system. Maintenance servicing of suspension systems. Brake systems, types and servicing techniques. Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing. Practical: 1. Adjustment of pedal play in clutch, brake, hand brake and steering wheel. 2. Removal of tyre & tube.3. Wheel balancing and alignment 4. Brake bleeding and adjustment		CO-3 BTL-3
MODULE 4 - ELECTRICAL SYSTEM MAINTENANCE - SERVICING AND REPAIRS		(6L+6P)
Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments. Practical: Fault diagnosis of ignition, starting and charging system.		CO-4 BTL-3
MODULE 5 - MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VEHICLE BODY		(6L+6P)
Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anti-corrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, Minor and major repairs. Door locks and window glass actuating system maintenance. Practical: 1. Calibration of fuel injection pump 2. Fault diagnosis of petrol and diesel fuel system and filters & air cleaners. LIST OF EQUIPMENTS: 1. Engine Analyzer 2. Cylinder compression pressure gauge 3. Vacuum gauge 4. Tachometer 5. Wheel balancer and 6. Wheel aligner 7. Tyre remover 8. Bearing puller 9. Cylinder reboring machine 10. Valve grinding machine 11. Valve lapping machine 12. Fuel injection calibration test bench with nozzle tester		CO-5 BTL-3
TEXT BOOKS		
1.	John Duke "Fleet Management", McGraw-Hill Co. USA, reprint 2012.	
2.	Jigar A. Doshi, Dhruv U. Panchal and Jayesh P. Maniar, Vehicle Maintenance and Garage Practice , Prentice Hall of India, 2014.	
REFERENCE BOOKS		
1	James D Halderman - Advanced Engine Performance Diagnosis - PHI - 2011.	
2	Service Manuals from Different Vehicle Manufacturers.	
E BOOKS		

1	https://books.google.co.in/books?id=WMAwBTOKbvgC&pg=PA8&dq=vehicle+diagnostics&hl=en&sa=X&ved=0ahUKEwiXxd2Jst7ZAhWMO48KHQhfAAcQ6AEILDAB#v=onepage&q=vehicle%20diagnostics&f=false
2	https://books.google.co.in/books?id=gnE1DgAAQBAJ&printsec=frontcover&dq=automotive+technology&hl=en&sa=X&ved=0ahUKEwicvrO-st7ZAhUGSY8KHh04A3UQ6AEIOzAD#v=onepage&q=automotive%20technology&f=false
MOOC	
1	https://www.udemy.com/topic/car-repair/
2	https://alison.com/topic/learn/144741/introduction-to-car-maintenance-learning-outcomes

COURSE TITLE	ADVANCED VEHICLE TECHNOLOGY				CREDITS	3								
COURSE CODE	EAT51017	COURSE CATEGORY	PC	L-T-P-S	2-0-2-2									
Version	1.0	Approval Details	36 TH ACM	LEARNING LEVEL	BTL-3									
ASSESSMENT SCHEME														
CIA					ESE									
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical								
15%	15%	10%	5%	5%	25%	25%								
Course Description	This course gives the knowledge on new trends in power plants; new developments in suspension, brakes and safety; technology for noise and pollution reduction; new developments in vehicle operation and control; concept of vehicle automated trucks.													
Course Objective	1. To interpret on new trends in power plants 2. To discuss on new developments in suspension, brakes and safety 3. To design new technology for noise and pollution reduction 4. To identify new developments in vehicle operation and control 5. To develop concept of vehicle automated trucks													
Course Outcome	Upon completion of this course, the students will be able to 1. Interpret on new trends in power plants 2. Discuss on new developments in suspension, brakes and safety 3. Design new technology for noise and pollution reduction 4. Identify new developments in vehicle operation and control 5. Develop concept of vehicle automated trucks													
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO -2
CO-1	3	1	3	1	3	-	-	-	-	-	2	3	3	1
CO-2	2	1	2	3	3	-	-	-	-	-	1	2	2	2
CO-3	3	2	1	2	2	-	-	-	-	-	2	3	3	2
CO-4	2	1	2	3	2	-	-	-	-	-	1	2	2	1
CO-5	3	1	3	3	2	-	-	-	-	-	1	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: TRENDS IN POWER PLANTS												(6L+ 6P)		
Stratified charge / lean burn engines - Hydrogen engines -LPG/ CNG Engines – Biogas Engines.												CO-1 BTL-3		

Lab Experiments 1. Performance test on LPG/ CNG Engine		
Equipment Required 1. LPG/ CNG Engine		
MODULE 2: SUSPENSION, BRAKES AND SAFETY		(6L+ 6P)
Air suspension - Closed loop suspension - antiskid braking system, Brake Retarders, Regenerative braking -vehicle safety - air bags - crash resistance - passenger comfort.		
Lab Experiments 1. Test on suspension system 2. Test on brake		CO-2 BTL-3
Equipment Required 1. Suspension systems 2. Brakes		
MODULE 3: NOISE & POLLUTION		(6L+ 6P)
Noise- Reduction of noise - Internal & external pollution control through alternate fuels / power plants - Catalytic converters and filters for particulate emission.		
Lab Experiments 1. Measurement of pollution in Engines 2. Testing on catalytic convertors		CO-3 BTL-3
Equipment Required 1. Gas analyzer 2. Smoke meter 3. Catalytic Convertor		
MODULE 4: VEHICLE OPERATION AND CONTROL		(6L+ 6P)
Computer control for pollution, noise and fuel economy - Transducers and actuators - Information technology for receiving proper information and operation of the vehicle like optimum speed and direction.		
Lab Experiments 1. Measuring noise 2. Measuring fuel economy 3. Testing actuator		CO-4 BTL-3
Equipment Required 1. Noise measuring device 2. Fuel measuring device 3. Actuator		
MODULE 5: VEHICLE AUTOMATED TRACKS		(6L+ 6P)
Preparation and maintenance of proper road network - National highway network with automated roads and vehicles - Satellite control of vehicle operation for safe and fast travel.- Hyperloop Technology.		
Lab Experiments 1. Procedure for road network maintenance		CO-5 BTL-3
Equipment Required		
TEXT BOOKS		
1.	Heinz Heisler, "Advanced Vehicle Technology" - Arnold Publication	
REFERENCE BOOKS		
1	Beranek.L.L., Noise reduction, McGraw Hill Book Co., Inc., Newyork, 2013.	

2	Bosch Hand Book, 3rd Edition, SAE, 2013
E Resources for Reference	
1.	https://books.google.co.in/books?id=aLgNET9YkS0C&pg=PA368&dq=modern+vehicle+technology+by+heinz&hl=en&sa=X&ved=0ahUKEwjsq9nVpZHaAhVKo48KHfXqDaAQ6AEIjAA#v=onepage&q=modern%20vehicle%20technology%20by%20heinz&f=false
2.	https://books.google.co.in/books?id=Ek0Cxo4rfnMC&printsec=frontcover&dq=modern+vehicle+technology+by+heinz&hl=en&sa=X&ved=0ahUKEwjsq9nVpZHaAhVKo48KHfXqDaAQ6AEINTAD#v=onepage&q=modern%20vehicle%20technology%20by%20heinz&f=false
MOOC	
1.	www.moditech.com/en/training/modern-vehicle-technology-special
2.	https://www.edx.org/course/hybrid-vehicles

COURSE TITLE		Research Methodology & IPR						CREDITS		2				
COURSE CODE		EGE51005		COURSE CATEGORY			ES		L-T-P-S		2-0-0-2			
Version		1.0		Approval Details			36 th ACM		LEARNING LEVEL		BTL-3			
ASSESSMENT SCHEME														
CIA												ESE		
First Periodical Assessment		Second Periodical Assessment		Seminar/Assignments/Project		Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”		Attendance						
15%		15%		10%		5%		5%						
Course Description		The students shall develop a detailed insight about various aspects of Research Methodology and IPR. Research Process and its type will be discussed in the Module I, whereas research variables were briefed in the Module II. Detailed procedure of data preparation and analysis will be taught in the Module III, report writing will be discussed in the Module IV. Finally, Module V will provide insights about IPR												
Course Objective		1. The course aims to identify and appreciate scientific inquiry 2. The course also equips the students to develop the skill of writing research proposals 3. The course aims to plan a systematic outlook towards business Situations for the purpose of objective decision making, and the method of conducting scientific inquiry to solve organizational problems 4. The course also trains the students to analyze data and find solutions to the research problems 5. The course aims the students to Prepare research reports												
Course Outcome		Upon completion of this course, the students will be able to 1. Identify and appreciate scientific inquiry 2. Develop the skill of writing research proposals 3. Plan a systematic outlook towards business Situations for the purpose of objective decision making, and the method of conducting scientific inquiry to solve organizational problems 4. Consolidate data and write technical reports 5. Summarize the salient features of Intellectual Property Rights												
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	2	2	3	3	2	2	2	2	2	3	2	2
CO-2	2	3	1	1	3	3	2	3	2	3	2	3	1	1

CO-3	3	2	1	1	3	2	1	2	1	2	2	3	2	2
CO-4	2	3	1	1	3	2	1	1	3	3	2	3	2	2
CO-5	2	3	1	1	3	2	3	2	3	3	2	3	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: INTRODUCTION													(6L)	
Business Research – Definition and Significance – the research process – Types of Research – Exploratory and causal Research–Theoretical and empirical Research – Cross – Sectional and time – series Research – Research questions / Problems – Research objectives – Research hypotheses – characteristics – Research in an evolutionary perspective – the role of theory in research. Suggested Readings: 1. Research Hypotheses													CO-1 BTL-3	
MODULE 2: RESEARCH DESIGN AND MEASUREMENT													(6L)	
Research design – Definition – types of research design –Variables in Research – Measurement and Scaling – Different scales – Construction of instrument –Validity and Reliability of instrument. Types of data – Primary Vs Secondary data – Methods of primary data collection – Survey Vs Observation – Experiments – Construction of Questionnaire and instrument – Types of Validity –Sampling plan–Sample size– determinants optimal sample size – sampling techniques – Sampling methods. Suggested Readings: 1. Sampling Techniques													CO-2 BTL-3	
MODULE 3: DATA PREPARATION AND ANALYSIS													(6L)	
Data Preparation – editing – Coding –Data entry – Validity of data – Qualitative Vs Quantitative data analyses – Applications of Bivariate and Multivariate statistical techniques, Factor analysis, Discriminant analysis, Cluster analysis, Multiple regression and Correlation, Multidimensional scaling. Suggested Readings: 1. Cluster Analysis													CO-3 BTL-3	
MODULE 4: REPORT DESIGN, WRITING AND ETHICS IN BUSINESS RESEARCH													(6L)	
Research report –Types – Contents of report – need for executive summary – Chaptalization– contents of chapter – report writing – the role of audience – readability – comprehension – tone – final proof – report format – title of the report Suggested Readings: 1. Report Writing													CO-4 BTL-3	
MODULE 5: INTRODUCTION TO IPRS (INTELLECTUAL PROPERTY RIGHTS)													(6L)	
Meaning, importance – Various Types of Intellectual Property Rights – Patent, Copyrights, Geographical Indication, trade Secrete, Industrial Design – Registration, rights – World Intellectual Property Organization (WIPO)- Intellectual Property Rights in India Suggested Readings: 1. Patent and Copyrights													CO-5 BTL-3	
BOOKS														
1.	UmaSekaran, ResearchMethodsforBusiness,WileyPublications,2011.													
2.	DonaldR.CooperandPamela S.Schindler-BusinessResearchMethods-TataMcGrawHill,2010													
REFERENCE BOOKS														
1	Naresh K Malhotra –Marketing Research: An Applied Orientation, Pearson Education,4thEdition,2010.													
2	T.N.Srivastava&ShailajaRego BusinessResearchMethodology,TataMcGrawHill,2013,Edition.2012													
3	Uma Sekaran and Roger Bougie, Research methods for Business, 5th Edition, Wiley India, NewDelhi,2012.													
4	Karuppasamy & H.C.Bindusha, A Practical Approach to Intellectual Property Rights, Himalaya Publications, Mumbai, 2014.													
E Resources for Reference														
1	http://epgp.inflibnet.ac.in/ahl.php?csrno=33(Socialworkeducation(P05-M29))													
2.	http://epgp.inflibnet.ac.in/ahl.php?csrno=33(Socialworkeducation(P05-M01))													

3.	http://epgp.inflibnet.ac.in/ahl.php?csrno=33 (Social work education (P05-M09))
4.	http://epgp.inflibnet.ac.in/ahl.php?csrno=33 (Social work education (P05-M12))
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc23_ge36/preview
2.	https://nptel.ac.in/courses/127106227

COURSE TITLE	PROJECT PHASE-1								CREDITS		3			
COURSE CODE	EAT51806			COURSE CATEGORY		EEC			L-T-P-S		0-0-6-6			
Version	1.0			Approval Details		36th ACM			LEARNING LEVEL		BTL-5			
ASSESSMENT SCHEME														
FIRST REVIEW		SECOND REVIEW						THIRD REVIEW				PROJECT REPORT & VIVAVOCE		
20%		20%						10%				50%		
Course Description		This course is designed to offer a diverse range of objectives, spanning from design and practical implementation to computational work and research-based projects. Every proposed project presents a pathway to accomplish the desired learning outcomes. The core purpose of this module is to serve as a platform for students to not only develop and integrate their existing knowledge and skills but also to explore and, in certain cases, contribute to new knowledge through literature review, experimentation, or modelling and analysis, as applicable. Moreover, the module places a strong emphasis on recognizing and nurturing students' curiosity and motivation. It strives to provide a gratifying learning experience through close interaction and guidance from an academic supervisor.												
Course Objective		The course will enable the students to: 1. Undertake theoretical studies, computer simulations and hardware construction based on the literature review performed. 2. Produce progress reports on the work completed and maintain to schedule the time frame of the project 3. Finally deliver a seminar and prepare a report/paper to present in a forum involving paper presentations and demonstration of the operational hardware and software												
Course Outcome		Upon completion of this course, the students will be able to 1. Categorize the topic of interest and identify the project domain based on the societal / industry requirements 2. Reproducing the existing system and feasibility of the proposed project 3. Articulate the methodology of the project based on comprehensive Literature survey and break down to point out the methods and strategies for implementation.												
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	1	2	0	0	2	1	1	2	1	1	2	2	1
CO-2	3	1	2	0	0	2	1	1	2	1	1	2	2	2

CO-3	3	1	2	0	0	2	1	1	2	1	1	2	2	1														
1: Weakly related, 2: Moderately related and 3: Strongly related																												
The Project Work shall be carried out in the field of Automobile Engineering. Students shall work in convenient groups of not more than four members in a group. Every Project Work shall have a Supervisor. During this period the supervisor shall guide the students to implement the project. The students shall give periodical presentations of the progress made in the Project Work. Each group shall finally produce a report covering background information, literature survey, problem statement, project work details and conclusions. This final report shall be typewritten form as specified in the guidelines. Assessment Review / Exam.																												
<table><tr><th colspan="2">Assessment</th></tr><tr><th>Review / Exam</th><th>Weightage</th></tr><tr><td>First Review</td><td>20%</td></tr><tr><td>Second review</td><td>20%</td></tr><tr><td>Third review & DEMO</td><td>10%</td></tr><tr><td>Project Report & viva Voce</td><td>50%</td></tr><tr><td>TOTAL</td><td>100%</td></tr></table>															Assessment		Review / Exam	Weightage	First Review	20%	Second review	20%	Third review & DEMO	10%	Project Report & viva Voce	50%	TOTAL	100%
Assessment																												
Review / Exam	Weightage																											
First Review	20%																											
Second review	20%																											
Third review & DEMO	10%																											
Project Report & viva Voce	50%																											
TOTAL	100%																											
A committee shall be constituted by the HoD for the Review																												

Assessment Rubrics

Parameter	Weightage (%)
Title & Objectives	5.0
Review of Literature (RL)	10.0
Design / Implementation	10.0
Methodology	5.0
Planning of Project Work	5.0
Testing Environment / Test Cases	5.0
Analytical thinking*	5.0
Technical Knowledge*	5.0
Presentation*	10.0
Demonstration*	5.0
Individual Roles Distribution* (Individual Objectives in the project work)	5.0
Individual Contributions* (Towards the individual objectives in the project work)	5.0
Deliverables	5.0
Team- work	5.0
Report / Thesis	5.0
Publication, Patent, Funding, Competitions	5.0
Peer Assessment*	5.0

* - Attributes for individual contribution

Semester VIII

COURSE TITLE		PROJECT PHASE-2				CREDITS		13						
COURSE CODE		EAT51807		COURSE CATEGORY		EEC		L-T-P-S		0-0-26-10				
Version		1.0		Approval Details		37 th ACM dated 20.01.2023		LEARNIN G LEVEL		BTL-5				
ASSESSMENT SCHEME														
FIRST REVIEW		SECOND REVIEW				THIRD REVIEW				PROJECT REPORT & VIVAVOCE				
20%		20%				10%				50%				
Course Description		This course encompasses a diverse range of objectives, catering to both design and manufacturing, computational work, and research-oriented projects. Regardless of the chosen project, all participants will have ample opportunities to attain the intended learning outcomes. The primary goal of this module is to furnish students with a platform to foster and consolidate their knowledge and skills, encouraging them to explore and potentially contribute to new knowledge through various means such as literature review, experimentation, or modelling and analysis when relevant. Furthermore, the course places significant emphasis on nurturing curiosity and self-motivation, promoting a fulfilling and engaging experience for students as they engage in close collaboration with their academic supervisor.												
Course Objective		The course will enable the students to: 1. Undertake theoretical studies, computer simulations and hardware construction based on the literature review performed. 2. Produce progress reports on the work completed and maintain to schedule the time frame of the project 3. Finally deliver a seminar and prepare a report/paper to present in a forum involving paper presentations and demonstration of the operational hardware and software												
Course Outcome		Upon completion of this course, the students will be able to 1. Build and demonstrate the prototype based on the technical knowledge gained in the phase 1 2. Design Engineering solutions to real time problems utilizing system approach 3. Illustrate and interpret the graphical results obtained 4. Analyze, Evaluate and compare the performance of the results. 5. Communicate with Engineers, peer team members and professionals												
CO, PO AND PSO MAPPING														
CO	PO-1	P O-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PS O-2
CO-1	3	3	2	2	3	1	1	1	3	1	3	1	3	2
CO-2	3	3	2	2	3	1	1	1	3	1	3	1	2	3
CO-3	3	3	2	2	3	1	1	1	3	1	3	1	3	2
CO-4	3	3	2	2	3	1	1	1	3	1	3	1	2	3
CO-5	3	3	2	2	3	1	1	1	3	1	3	1	3	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
The Project Work shall be carried out in the field of Automobile Engineering. Students shall work in convenient groups of not more than four members in a group. Every Project Work shall have a Supervisor.														

During this period the supervisor shall guide the students to implement the project. The students shall give periodical presentations of the progress made in the Project Work.

Each group shall finally produce a report covering background information, literature survey, problem statement, project work details and conclusions. This final report shall be typewritten form as specified in the guidelines. Assessment Review / Exam.

Assessment	
Review / Exam	Weightage
First Review	20%
Second review	20%
Third review & DEMO	10%
Project Report & viva Voce	50%
TOTAL	100%

A committee shall be constituted by the HoD for the Review

Assessment Rubrics

Parameter	Weightage (%)
Title & Objectives	5.0
Review of Literature (RL)	10.0
Design / Implementation	10.0
Methodology	5.0
Planning of Project Work	5.0
Testing Environment / Test Cases	5.0
Analytical thinking*	5.0
Technical Knowledge*	5.0
Presentation*	10.0
Demonstration*	5.0
Individual Roles Distribution* (Individual Objectives in the project work)	5.0
Individual Contributions* (Towards the individual objectives in the project work)	5.0
Deliverables	5.0
Team- work	5.0
Report / Thesis	5.0
Publication, Patent, Funding, Competitions	5.0
Peer Assessment*	5.0

* - Attributes for individual contribution

EVALUATION PARAMETERS FOR ASSESSMENT

To be followed same as approved for Project Phase I

Department Electives (DE)

	Vertical 1	Vertical 2	Vertical 3	Vertical 4
SEM	EV Technology	Intelligent Mobility	Engine /Vehicle Technology	Design/ Manufacturing
III	Electric Drives and Control	Instrumentation for Intelligent Mobility	Alternative Fuels and Energy Systems	Production Technology
	OR	OR	OR	OR
	Policy for E-Mobility	Intelligent Transportation system	Vehicle body engineering	Integrated Product Design and Development
IV	Battery Technology	Advanced Driver Assistance System	Automotive Pollution and Control	Computer Integrated Manufacturing
	OR	OR	OR	OR
	Electric and Hybrid vehicles	V2V and V2X Technology	Off Road Vehicles	Process Planning and Cost Estimation
V	Charging Technology	ECU Model Based System Design	Vehicle Design Data Characteristics	Digital Manufacturing
	OR	OR	OR	OR
	Power Electronics for EV	Cyber security for Automotive Engineers	Design of Engine Exhaust system	Industrial Automation and Robotics
VI	Modelling and Simulation of EV	Automotive Safety Systems	Renewable Source of Energy	Design of Experiments
	OR	OR	OR	OR
	Coding for EV	Automotive Electronic Management System	Automotive Heating Ventilation Air Conditioning (HVAC)	Industrial Engineering and Management
VII	Computer Architecture and Data Analytics	Self-Driving Cars	Vibration and Noise Control	Computational Fluid Dynamics
	OR	OR	OR	OR
	Smart Grid for EV	Pose estimation and state estimation of self-driving cars	Fuel Cell Technology	Lean Manufacturing and Six sigma

Syllabus for Department Electives

Semester –III

Vertical 1: Electric Vehicle Technology

COURSE TITLE	ELECTRIC DRIVES AND CONTROL			CREDITS	3
COURSE CODE	EAT51500	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA				ESE	

First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical								
15%	15%	10%	5%	5%	25%	25%								
Course Description	This course giving a broad overview of Electrical Drive Systems. It is assumed that the students have prior exposure to Electrical Machines and Power Electronics. The control principles of various DC and AC motors using solid state converters are discussed. Principles of selection of Electric Motors are introduced. Some of the applications of Electrical Drives are also highlighted.													
Course Objectives	1. To understand the basic concepts of different types of electrical machines and their performance 2. To study the different methods of starting D.C motors and induction motors. 3. To study the conventional and solid-state drives													
Course Outcomes	Upon completion of this course, the students will be able to 1. Understand the basics and types of electric drives with varying loading conditions. 2. Understand the speed torque characteristics of motor. 3. Understand modern speed control techniques to the motor. 4. Understand the various methods of speed control of DC motor. 5. Understand the AC motor control techniques for different applications.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	2	3	2	2	3	3	2	3	3	3	3	3	3
CO-2	3	2	3	2	2	3	3	2	3	3	3	3	3	3
CO-3	3	2	3	2	2	3	3	2	3	3	3	3	3	3
CO-4	3	2	3	2	2	3	3	2	3	3	3	3	3	3
CO-5	3	2	3	2	2	3	3	2	3	3	3	3	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction to Electric Drives													(6L+6P)	
Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors Practical: Speed control of universal motor using controlled rectifier Braking methods of DC motor													CO-1 BTL-3	
Module 2 – DRIVE MOTOR CHARACTERISTICS													(6L+6P)	
Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound – single phase and three phase induction motors. Practical: Load test on single phase Induction Motor Speed control of Induction Motor using V/f method and three phase voltage source inverter													CO-2 BTL-3	
Module 3 – STARTING METHODS													(6L+6P)	

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors. Practical: Load test on three-phase squirrel cage Induction motor Speed control of three phase slip ring Induction Motor	CO-3 BTL-3
Module 4 – CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES	(6L+6P)
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system – Using controlled rectifiers and DC choppers –applications. Practical: Speed control of DC shunt motor Load test on DC Shunt motor Load test on DC Series motor	CO-4 BTL-3
Module 5 – CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES	(6L+6P)
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications. Practical: No load and blocked rotor tests on three phase induction motor Load test on three-phase induction motor.	CO-5 BTL-3
TEXT BOOKS	
1.	VEDAM SUBRAHMANYAM, “Electric Drives (concepts and applications)”, Tata McGrawHill, 2001
2.	NAGRATH.I.J. & KOTHARI.D.P, “Electrical Machines”, Tata McGraw-Hill, 1998
REFERENCE BOOKS	
1.	PILLAI.S.K “ A first course on Electric drives”, Wiley Eastern Limited, 1998
2.	M.D.SINGH, K.B.KHANCHANDANI, “Power Electronics”, Tata McGraw-Hill, 1998
E BOOKS	
1.	H.Partab, “Art and Science and Utilisation of electrical energy”, Dhanpat Rai and Sons, 1994
2.	https://docs.google.com/document/d/1VUiztkaSkQlgCO-IDxDtgVQCLsMD2vc4/edit?usp=share_link&oid=100135410077428077019&rtpof=true&sd=true
MOOC	
1.	https://professional.mit.edu/course-catalog/design-electric-motors-generators-and-drive-systems
2.	https://archive.nptel.ac.in/courses/108/104/108104140/
3.	https://archive.nptel.ac.in/courses/108/104/108104011/

COURSE TITLE	POLICY FOR E-MOBILITY			CREDITS	3
COURSE CODE	EAT51501	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA				ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory Practical
15%	15%	10%	5%	5%	25% 25%
Course Description	The course provides an overall insight about policies of implementing E-Mobility across the globe. Feedback collection and stakeholder involvement with its significances will				

	be educated to the learners. Finally, course also provide detailed insights about supply and demand side policies as well as sustainable ecosystem development for E-Mobility													
Course Objectives	1. Examine the need of e-mobility and explain the process of feedback collection and stakeholder’s involvement. 2. Explain the Supply Side Policy Measures and types of Subsidies 3. Explain Demand side policy measures and regulatory bodies 4. Analyze the importance in building sustainable charging infrastructure. 5. Investigate the challenges and opportunities in developing an ecosystem for E-Mobility													
Course Outcomes	Upon completion of this course, the students will be able to 1. Explain the need of e-mobility and explain the process of feedback collection and stakeholder’s involvement. 2. Explain the Supply Side Policy Measures and types of Subsidies 3. Explain Demand side policy measures and regulatory bodies 4. Analyze the importance in building sustainable charging infrastructure. 5. Investigate the challenges and opportunities in developing an ecosystem for E-Mobility													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	1	2	1	1	2	3	2	1	1	1	3	3	3
CO-2	3	1	2	1	1	2	3	2	1	1	1	3	3	3
CO-3	3	1	2	1	1	2	3	2	1	1	1	3	3	3
CO-4	3	1	2	1	1	2	3	2	1	1	1	3	3	3
CO-5	3	1	2	1	1	2	3	2	1	1	1	3	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction													(6L+6P)	
EV– Layout – Policy – National – International – Objectives – Stakeholders – Data Collection													CO-1 BTL-3	
Module 2 – Supply Side Policy Measures													(6L+6P)	
Eligibility – Research & Development – Investment Promotion Subsidy – Turnover-based Subsidy – Taxes – Capital Subsidy – Electricity Tax Exemption – Stamp Duty – Subsidy on Cost of Land – Employment & Intellectual Property Creation Incentive													CO-2 BTL-3	
Module 3 – Demand Side Measures													(6L+6P)	
Support Measures – Electrification of Vehicular Fleets in the State – Promoting EVs in Manufacturing Facilities– Demand Aggregation – Regulatory Measures & Concessions – Revised Transport Regulation of Electric Vehicles – Private Vehicles, Shared Mobility & Commercial Vehicle Segments – Road Tax/Registration Charges													CO-3 BTL-3	
Module 4 – Charging Infrastructure													(6L+6P)	
Government Interventions – Tariff for EV Charging – Incentives for Charging Stations – Public Charging Stations – Private e-Aggregator Charging Stations – Incentives for Public Battery Swapping Stations													CO-4 BTL-3	
Module 5 – Ecosystem Development													(6L+6P)	
Capacity Building & Skilling R&D and Business Incubation Creation of a Circular Sustainable Economy Creation of EV Parks & Vendor Ecosystem Promoting Startups in the EV Sector Investment Facilitation Safety & Awareness Sanctioning & Implementing Agency													CO-5 BTL-3	
TEXT BOOKS														

1.	Electrical Vehicle Technology: The Future Towards Eco-Friendly Technology. Prof. Sunil R. Pawar, Notion Press; 1st edition, ISBN-10: 1685545610
2.	EV Engineering Fundamentals: A beginner's guide to e-mobility, Ashhar Ahmed Shaikh, Notion Press; 1st edition (12 July 2022), ISBN-13: 979-8887496443
REFERENCE BOOKS	
1.	Electric Cars: The Ultimate Guide, Keith Chamberlain, 2019, Greentech Publishing, ISBN-13 : 978-1916141407
2.	Bosch Automotive Handbook, 10 th Edition Robert Bosch ISBN of 978-0-7680-9567-8
3	The Future of Electric Vehicles: A Sustainable Solution, Taiwo Ayodele, ISBN-13 : 978-1690837107, 2019
4	Hydrogen – A fuel for Automatic Engines, Prashukumar G P, ISTE
5	Fuel Cells: Theory and Applications, Hart A B and Womack G J, Chapman and Hall
6	Tomorrow's Energy – Hydrogen Fuel Cells and the Prospects for Cleaner Planet, Peter Hoffman, MIT
E BOOKS	
1	https://investingintamilnadu.com/DIGIGOV/StaticAttachment?AttachmentFileName=/pdf/poli_noti/TN_Electric_Vehicles_Policy_2023.pdf
2	https://powermin.gov.in/sites/default/files/uploads/EV/Tamilnadu.pdf
3	https://www.iea.org/reports/ev-city-casebook-and-policy-guide-2021-edition
4	https://www.niti.gov.in/sites/default/files/2021-08/HandbookforEVChargingInfrastructureImplementation081221.pdf
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc21_ee112/preview
2.	https://archive.nptel.ac.in/courses/108/103/108103009/
3	https://onlinecourses.nptel.ac.in/noc22_ee53/preview

Vertical 2: INTELLIGENT MOBILITY

COURSE TITLE	INSTRUMENTATION FOR INTELLIGENT MOBILITY			CREDITS	3	
COURSE CODE	EAT51502	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2	
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-5	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	This course will provide complete knowledge to the undergraduate students on Understand commonly used hardware used for self-driving cars, Identify the main components of the self-driving software stack, Program vehicle modelling and control, Analyze the safety frameworks and current industry practices for vehicle development					
Course Objectives	1. To impart the knowledge on Self-Driving Hardware and Software Architectures 2. To educate about condition of Object Detection in an Urban Environment 3. To impart the knowledge on Sensor Fusion & Perception 4. To instruct the knowledge on Localization and Planning 5. To educate about Control & Trajectory Tracking for Autonomous Vehicles					

Course Outcomes	Upon completion of this course, the students will be able to 1. understand the Self-Driving Hardware and Software Architectures 2. understand the Object Detection in an Urban Environment 3. understand the Sensor Fusion & Perception 4. understand the Localization and Planning 5. understand the Control & Trajectory Tracking for Autonomous Vehicles													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO-1	3	3	2	2	2	1	1	-	-	-	1	-	3	1
CO-2	3	2	2	3	2	1	-	-	-	-	-	-	3	2
CO-3	2	3	3	2	1	1	1	-	-	-	-	-	2	2
CO-4	2	2	3	2	1	1	-	-	-	-	1	-	3	3
CO-5	3	3	3	3	2	1	-	-	-	-	1	-	2	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module I – Introduction													(6L+6P)	
The Requirements for Autonomy- Self-Driving Hardware and Software Architectures Safety Assurance for Autonomous Vehicles- Vehicle Longitudinal Control- Vehicle Lateral Control													CO-1 BTL-2	
Module II – Computer Vision													(6L+6P)	
Object Detection in an Urban Environment - The Machine Learning Workflow - Sensor & Camera Calibration - From Linear Regression to Feedforward Neural Networks - Image Classification with Convolutional Neural Networks - Object Detection in Images													CO-2 BTL-2	
Module III – Sensor Fusion													(6L+6P)	
Introduction to Sensor Fusion & Perception - The Lidar Sensor- 3D Object Detection - 3D lidar point clouds - Kalman Filters - Extended Kalman Filters - Multi-Tracking Tracking													CO-3 BTL-3	
Module IV – Localization and Planning													(6L+6P)	
Introduction to Localization- Markov Localization- Creating Scan Matching Algorithms- Utilizing Scan Matching in 3D- Scan Matching Localization - Motion Planning & Decision Making for Autonomous Vehicles - Behavior Planning - Trajectory Generation - Motion Planning - a decision making framework to plan a vehicle’s motion in an urban environment													CO-4 BTL-2	
Module V – Control & Trajectory Tracking for Autonomous Vehicles													(6L+6P)	
Control & Trajectory Tracking for Autonomous Vehicles – PID Control PID and MPC for trajectory tracking using the PID controller - controller with non-linear dynamics - Recognize the observation of the state of the vehicle (position, velocity), the action (steering, accelerator, brake) and the possible perturbations													CO-5 BTL-3	
TEXT BOOKS														
1.	Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS													
2.	Michael E. McGrath, Autonomous Vehicles: Opportunities, Strategies and Disruptions: Updated and Expanded Second Edition 2019													
REFERENCE BOOKS														
1.	Andreas Herrmann and Johann Jungwirth, Inventing Mobility for All: Mastering Mobility-as-a-service With Self-driving Vehicles 2022													
2.														
E BOOKS														

1.	Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Creating Autonomous Vehicle Systems, Morgan & Claypool Publication 2020
2.	Sreevatsan Bhaskaran, Kai Zhou, Andrew Baab, Ronald Calhoun "Autonomous Vehicle Lidar: A Tutorial" Kindle
3.	
MOOC	
1.	https://www.coursera.org/learn/intro-self-driving-cars
2.	https://www.udacity.com/course/self-driving-car-engineer-nanodegree--nd0013

COURSE TITLE	INTELLIGENT TRANSPORTATION SYSTEM				CREDITS	3								
COURSE CODE	EAT51503	COURSE CATEGORY	DE		L-T-P-S	2-0-2-2								
Version	1.0	Approval Details	36 th ACM		LEARNING LEVEL	BTL-3								
ASSESSMENT SCHEME														
CIA					ESE									
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance	Theory	Practical							
15%	15%	10%	5%		5%	25%	25%							
Course Description	This course provides knowledge on intelligent transport system and vehicle to vehicle technology													
Course Objectives	1. To discuss on Intelligent Transportation Systems (ITS) 2. To demonstrate telecommunications in ITS 3. To design ITS functional areas 4. To describe ITS user needs and services 5. To develop Vehicle-to-Vehicle (V2V) Communications													
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on Intelligent Transportation Systems (ITS) 2. Demonstrate telecommunications in ITS 3. Design ITS functional areas 4. Describe ITS user needs and services 5. Develop Vehicle-to-Vehicle (V2V) Communications													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PS O-1	PS O-2
CO-1	2	2	1	3	-	1	-	1	-	1	1	1	1	2
CO-2	2	3	2	2	1	-	1	1	-	2	1	2	2	1
CO-3	1	2	1	2	-	-	-	1	-	1	1	1	1	2
CO-4	2	2	1	2	-	2	1	2	2	2	1	2	2	1
CO-5	2	1	1	2	1	-	-	1	-	1	1	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Introduction to Intelligent Transportation Systems (ITS)											(6L+6P)			
Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.											CO-1 BTL-2			
MODULE 2: Telecommunications in ITS											(6L+6P)			

Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centers (TMC). Vehicle – Road side communication – Vehicle Positioning System.		CO-2 BTL-2
MODULE 3: ITS functional areas		(6L+6P)
ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).		CO-3 BTL-3
MODULE 4: ITS User Needs and Services		(6L+6P)
ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management. Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.		CO-4 BTL-2
MODULE 5: Vehicle-to-Vehicle (V2V) Communications		(6L+6P)
Dedicated short range communications (DSRC) –V2V vs V2I vs V2X vs V2N vs V2P - Importance of ongoing 5G development –GPS receivers and V2V –Laser Illuminated Detection and Ranging (LiDAR) –Inertial navigation systems –Characteristics of a wireless mesh network –V2V and Cybersecurity.		CO-5 BTL-2
TEXT BOOKS		
1	Kan Paul Chen, John Miles, ITS Handbook: Recommendations for World Road Association (PIARC)	
2	Sussman, J. M., Perspective on ITS, Artech House Publishers, 2015.	
3	Dimitrakopoulos, George: Current Technologies in Vehicular Communication, Springer, 2017.	
REFERENCE		
1	National ITS Architecture Documentation, US Department of Transportation, 2017.	

Vertical 3: ENGINE AND VEHICLE TECHNOLOGY

COURSE TITLE	ALTERNATIVE FUELS AND ENERGY SYSTEMS			CREDITS	3
COURSE CODE	EAT51504	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	End Semester Examination
15%	15%	10%	5%	5%	Theory 25%
					Practical 25%
Course Description	This course is based on the developing areas of alternate fuels integrating both the theoretical and practical training for engineering students. Application of the concepts to learn the possible fuels that are available in the market for future use.				

Course Objectives	1. To gain knowledge on available alternate fuels 2. To provide a strong foundation on alcohol usage. 3. To illustrate fuels from gases. 4. To evaluate the performance of vegetable oils. 5. To make the students understand the hybrid vehicles.													
Course Outcomes	Upon completion of this course, the students will be able to 1. to familiarize on various alternate fuels. 2. to gain knowledge on the details of methanol and ethanol usage, storage, chemical structure. 3. to acquire knowledge of natural gas, LPG, hydrogen and biogas. 4. to attain the performance characteristics of various vegetable oils. 5. to familiarize with electric and hybrid vehicles.													
Prerequisites: Knowledge in fundamentals of Engines														
CO, PO AND PSO MAPPING														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	3	-	-	3	1	2
CO2	3	3	-	2	3	-	-	-	3	-	-	3	2	1
CO3	3	3	-	-	1	-	-	-	3	-	-	3	2	2
CO4	3	3	-	2	-	-	-	-	3	-	-	3	1	2
CO5	3	3	-	-	3	-	-	-	3	-	-	3	1	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Introduction (6L + 6P)														
Need for alternate fuel- Evolution- Availability of alternate fuels, general use of alcohols, LPG, Hydrogen, Ammonia, CNG and LNG, Vegetable oils, water and biogas, Merits and demerits of various alternate fuels. Government norms and Subsidiary. Introduction to alternate energy sources. Like EV, Hybrid, Semi-Hybrid, Fuel cell, Nuclear Cars and Solar car. Practical component: properties of alternate fuels – Determination of properties													CO1 BTL3	
MODULE 2: ALCOHOLS (6L + 6P)														
Availability –Source- Types of Alcohols- Properties as engine fuel – Octane Number- Self Ignition Temperature- Calorific Value. Fuel and Engine Modification. Blending with diesel and gasoline- Dual Fuel Operation- Energy share Calculation. Performance in SI engine- Combustion characteristics in CI engines- Emission characteristics. Problems of using alcohols in diesel engine. DME, DEE properties- storage, Performance in SI & CI Engines. Practical component: Alcohol fuels – Determination of blending characteristics													CO2 BTL3	
MODULE 3: NATURAL GAS, LPG, HYDROGEN AND BIOGAS (6L + 6P)														
Availability of CNG, properties, Difficulties of using gaseous fuel in IC engines - Modification required using in engines, Performance and emission characteristics of CNG using LPG in SI & CI engines, Performance and emission of LPG. Hydrogen; Storage and handling, properties – flame speed- flammability. Performance emission and Combustion behavior of hydrogen in CI engine - safety aspects and design of gaseous fuel induction system. Practical component: Performance & Combustion Characteristics – To plot the graphs													CO3 BTL3	
MODULE 4: VEGETABLE OILS (6L + 6P)														
Design of engine, optimum selection of operating variables for control of emissions, Crankcase													CO4	

and evaporative emission control, Thermal and catalytic reactors, Elements of catalytic reactors, catalysts and substrates, Cold start HC control. EGR, Lean de-NOx catalysts, water injection, NOx traps and SCR. Diesel particulate filters (DPF), DPF regeneration, and Secondary air injection. Fuel modifications. Two stroke engine pollution control. Practical component: Biodiesel from Vegetable oils –characterization		BTL3
MODULE 5: ELECTRIC, HYBRID, FUEL CELL AND SOLAR CARS (6L + 6P)		
Need of E-Vehicle. Layout of an electric vehicle, Advantage and limitations, Specifications, System components, High energy and power density batteries, battery design - Charging Station – Cost analysis. Hybrid vehicle – type- advantages and limitations. Fuel cell vehicles, Solar powered vehicles. Practical component: Electronic control system – Determination of the OBD Techniques.		CO5 BTL3
TEXT BOOKS		
1	Richard. L. Bechfold - Alternative Fuels Guide Book - SAE International Warrendale - 2007.	
2	Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2017.	
REFERENCE BOOKS		
1.	Maheswar Dayal - "Energy today & tomorrow" - I & B Horishr India - 2012.	
2.	Nagpal & Sharma - "Power Plant Engineering" - Khanna Publishers - 2015.	
E BOOKS		
1.	https://link.springer.com/book/10.1007/978-1-349-04364-4	
2.	2nd Edition Handbook of Alternative Fuel Technologies, Edited By <u>Sunggyu Lee</u> , <u>James G. Speight</u> , <u>Sudarshan K. Loyalka</u>	
3.	https://www.intechopen.com/books/325	
MOOC		
1.	https://nptel.ac.in/courses/103101215	
2.	https://nptel.ac.in/courses/103103140	

COURSE TITLE	VEHICLE BODY ENGINEERING			CREDITS	3
COURSE CODE	EAT51505	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	End Semester Examination
15%	15%	10%	5%	5%	Theory 25%
					Practical 25%

Course Description	This course is based on the understanding the vehicle body construction details integrating both the theoretical and practical training for engineering students. Application of the concepts to learn the possible construction techniques that are available in the market.													
Course Objectives	1. To gain knowledge on car body design. 2. To provide a strong foundation on bus body 3. To illustrate knowledge on vehicle aerodynamics. 4. To remember the commercial vehicle body details. 5. To make the students understand the load and stress available in the vehicle body.													
Course Outcomes	Upon completion of this course, the students will be able to 1. To understand the details of car body and safety design aspects 2. To introduce bus body details and types of metal sections used 3. To broaden the understanding of vehicle aerodynamics and wind tunnel technology 4. To introduce commercial vehicle body details and driver’s seat design 5. To underline the importance of bus body loads and stress analysis													
Prerequisites: Knowledge in fundamentals of Engineering Mechanics														
CO, PO AND PSO MAPPING														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	-	-	-	-	-	-	1	-	-	2	1	1
CO2	2	3	-	2	3	-	-	-	3	-	-	3	1	2
CO3	3	2	-	-	1	-	-	-	2	-	-	2	2	1
CO4	3	3	-	2	-	-	-	-	3	-	-	3	1	1
CO5	1	3	-	-	3	-	-	-	2	-	-	2	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: CAR BODY DETAILS													(6L + 6P)	
Types car bodies – Visibility: regulations, driver’s visibility, methods of improving visibility – Safety: Safety design, constructional details of roof, under floor, bonnet, boot, wings etc.													CO1 BTL3	
MODULE 2: BUS BODY DETAILS													(6L + 6P)	
Types of bus bodies. Floor height, engine location – Entrance and exit location, Constructional details, frame construction, Double skin construction, Types of metal sections used, regulations, Conventional and integral type construction.													CO2 BTL3	
MODULE 3: VEHICLE AERODYNAMICS													(6L + 6P)	
Vehicle resistances and types. Various types of forces and moments. Various body optimization techniques for minimum drag. Principle of wind tunnel technology. Flow visualization techniques. Tests with scale models.													CO3 BTL3	
MODULE 4: COMMERCIAL VEHICLE BODY DETAILS													(6L + 6P)	
Construction of commercial vehicle bodies. Types of bodies – Flat platform, drop side, fixed side, tipper body, tanker body. Dimensions of driver’s seat in relation to controls. Drivers cab design.													CO4 BTL3	
MODULE 5: BODY LOADS AND STRESS ANALYSIS													(6L + 6P)	
Scaled structure – Shear panel method – Symmetric and Asymmetrical vertical loads in a car – Longitudinal loads – Different loading situations – Load distribution on vehicle structure –													CO5 BTL3	

Stress analysis of bus body structure under bending and torsion – Stress analysis in integral bus body. Analysis of shock and impulse force on vehicle bodies.	
TEXT BOOKS	
1	Powloski, J., 'Vehicle Body Engineering', Business Books Ltd., 2002
2	Sydney F. Page, "Body Engineering", 3rd ed. Chapman & Hill Ltd., London.
3	John Fenton, 'Vehicle Body Layout and Analysis', Mechanical Engineering Publication Ltd., London, 2013
REFERENCE BOOKS	
1.	David Crolla, "Automotive Engineering: Powertrain, Chassis System and Vehicle Body" 2013
2.	J.G. Giles, "Body Construction and Design", Vol. 6., Iffe Books/Butterworth & Co. London
E BOOKS	
1.	Wolf-Heinrich Hucho, "Aerodynamics of Road Vehicles" Published by SAE International, USA
2.	A. Robinson, W. A. Livesey, "The Repair of Vehicle Bodies" Published by Butterworth Heinemann LTD.
3.	John Fenton, "Handbook of Automotive Body Construction and Design Analysis" Professional Engineering Publishing.
MOOC	
1.	https://www.my-mooc.com/en/mooc/road-traffic-safety-in-automotive-engineering/

Vertical 4: DESIGN AND MANUFACTURING

COURSE TITLE	PRODUCTION TECHNOLOGY			CREDITS	3
COURSE CODE	EAT51506	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE
15%	15%	10%	5%	5%	Theory 25% Practical 25%
Course Description	To provide an understanding on the various types of production processes involved in the manufacturing of the automobile components such as casting, welding, machining, metal forming, power metallurgy etc.				
Course Objectives	The course should enable the student to: 1. Understand how the automobile components are manufactured. 2. Understand the various moulding process 3. Understand how the different machines are used for machining the components. 4. Understand how the components are joined together by methods such as, welding, brazing and soldering. 5. Understand the various manufacturing process such as forging, casting & machining.				

Course Outcomes	Upon completion of this course, the students will be able to													
	1. Able to apply the casting principles for automobile components													
	2. Able to perform various metal joining process													
	3. Able to identify suitable bulk deformation process for automobile applications													
	4. Able to perform various machining operation using lathe, milling etc													
5. Able to produce smooth metal surfaces using surface and cylindrical grinding machines														
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	2	3	2	3	1	1	-	1	2	1	2	2	2
CO-2	2	2	2	3	2	2	2	-	2	3	2	2	1	1
CO-3	3	3	3	1	3	1	1	-	1	2	1	2	2	2
CO-4	2	2	2	3	2	2	1	-	2	3	2	2	1	1
CO-5	3	2	3	1	3	1	2	-	1	2	2	2	2	2
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – CASTING PROCESSES													(6L+6P)	
Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Moulding sand Properties and testing – Cores –Types and applications – Melting furnaces – Principle of special casting processes - Shell, investment – Ceramic mould – Pressure die casting – Centrifugal Casting - CO casting - Stir casting - Defects in Sand casting. Plastic moulding - injection and blow moulding.													CO-1 BTL-3	
Practical Component														
1. Study on Green Sand Moulding														
Module 2 – METAL JOINING PROCESSES													(6L+6P)	
Fusion welding processes – Type of Gas welding – Flame characteristics – Filler and Flux materials – Arc welding, Electrodes, Coating and specifications – Principles and types of Resistance welding – Gas metal arc welding – Submerged arc welding – Electro slag welding – Gas Tungsten arc welding – Principle and application of special welding processes – Plasma arc welding – Thermit Welding – Electron beam welding – Friction welding – Diffusion welding – Weld defects – Brazing and soldering.													CO-2 BTL-3	
Practical Component														
1. MIG Welding														
2. TIG Welding														
Module 3 – MACHINING PROCESSES													(6L+6P)	
Lathe: working principle, classification, specification, accessories, work and tool holders, different operations on a lathe, turret and capstan lathes. Drilling and boring: machines - classification, specification, cutters speed & feed, jig borer - description, types and hole location procedures. Milling: classification, principle, parts – specification, milling cutters, indexing, milling processes and operations. Introduction to CNC machining.													CO-3 BTL-3	
Practical Component														
Vertical CNC Milling														
1. Linear Interpolation														
2. Circular Interpolation														
3. Facing ,drilling and counter boring														
Module 4 – METAL FORMING PROCESSES													(6L+6P)	
Hot and cold working processes - rolling, forging, drawing and extrusion processes, bending, hot spinning, shearing, tube and wire drawing, shot peening. Sheet metal working - blanking, piercing, punching, trimming, Bending - types of dies - progressive, compound and combination dies. Powder Metallurgy – Principles, Process, Applications & Limitations.													CO-4 BTL-3	

Practical Component Sheet Metal forming 1. Bending 2. Punching 3. Blanking 4. Trimming		
Module 5 – METAL FINISHING PROCESSES		(6L+6P)
Surface finishing processes: grinding processes, various types of grinders, work holding devices, grinding wheels and specification, selection of grinding wheels for specific applications - selection of cutting speed and work speed. Fine Finishing Process: Lapping, honing, and super finishing process. Practical Component 1. Study on introductions to Grinding		CO-5 BTL-3
TEXT BOOKS		
1.	HajraChoudhary S.K., “Elements of Manufacturing Technology”, Vol. I & II, 11th edition, Media Publishers, Mumbai, 1997.	
2.	Rao.P.N., “Manufacturing Technology, Metal Cutting and Machine Tools”, Tata McGraw-Hill, 2000..	
REFERENCE BOOKS		
1.	Jain K.C. Agarwal, L.N. “Metal Cutting Science and Production Technology”, 1 st edition, Khanna Publishers, 1986.	
2.	Chapman W.A.J., “Workshop Technology”, Vol. II, Arnold Publishers.	
E BOOKS		
1	MikellP. Groover https://drive.google.com/file/d/0B7JWdKw_4Q07M1F1Nm92TEUzcA/view	
2	Kalpakjian file:///C:/Users/Admin/Downloads/Serope%20Kalpakjian%20Steve%20Schmid%20Manufacturing.pdf	
3	http://www.erexams.com/2017/07/mechanical-all-subjects-ebook-free-pdf.html	
MOOC		
1	https://www.mooc-list.com/tags/manufacturing-processes	
2	https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x-0	
3	https://archive.nptel.ac.in/courses/112/103/112103244/	

COURSE TITLE	PRODUCT DESIGN AND DEVELOPMENT			CREDITS	3
COURSE CODE	EAT51507	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination
15%	15%	10%	5%	5%	Theory 25% Practical 25%
Course Description	The course aim is to provide student with the concepts and tools for the design of new products. The different approaches and methodologies for the design of new products, the stages of the design project, the design and the quality and the fundamental practices of design are review. Economic, financial and operational evaluations				

Course Objectives	1. Know about the basics of engineering design process 2. Understand the concepts of benchmarking for quality improvement 3. Learn about the systematic methods of creative designing 4. Know about the various steps involved in product design and development 5. To instil the new product design trends in engineering.													
Course Outcomes	Upon completion of this course, the students will be able to 1. Familiarize on the basics of engineering design process 2. Acquire the concepts of benchmarking for quality improvement 3. Gain knowledge on the systematic methods of creative designing 4. Acquire about the various steps involved in product design and development. 5. Confidence to create new product based on mechanical design engineering													
Prerequisites: Knowledge in fundamentals of CAD and Automotive Systems														
CO, PO AND PSO MAPPING														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	2	3	2	2	3	1	3	1	-	1	1
CO2	3	3	3	3	3	2	3	2	1	3	2	-	2	2
CO3	3	3	3	3	3	2	3	3	2	3	3	-	1	1
CO4	3	3	3	3	3	2	3	3	3	3	3	-	1	1
CO5	3	3	3	3	3	2	3	3	3	3	3	-	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: ENGINEERING DESIGN PROCESS													(6L + 6P)	
Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process–various phases of product development-planning for products – establishing markets- market segments- relevance of market research. Introduction to Automotive design, History of Automotive design, Car design brands & brand values and Brand history and Styling DNA and Case studies Practical component: To study the types of design and engineering design process. Review SolidWorks tutorials online													CO1 BTL3	
MODULE 2: BENCH MARKING													(6L + 6P)	
Identifying customer Needs and Desires, Usage Habits and Attitude Study –voice of customer –customer populations- hierarchy of human needs need gathering methods, affinity diagrams –needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality- product design specification-case studies. Practical component: Apply different techniques for Product design and put them in Drawing sheets													CO2 BTL3	
MODULE 3: CREATIVE DESIGN													(6L + 6P)	
Creative thinking –creativity and problem solving- creative thinking methods-generating design concepts-systematic methods for designing –functional decomposition – physical decomposition –functional representation –morphological methods. Concept Generation, Concept selection, Concept testing. Identification of Needs - Selection of Ideas -Screening of Ideas- Methods to Select the Best Idea Practical component: Students can do practices on different issues on voice of customer.													CO3 BTL3	
MODULE 4: PRODUCT DESIGN													(6L + 6P)	

Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method- weighted decision matrix –analytic hierarchy process –introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture. Practical component: How would you characterize Maruti Suzuki approach to PD. What do you think Maruti competitors will do.		CO4 BTL3
MODULE 5: PRODUCT DEVELOPMENT		(6L + 6P)
Industrial design –Advance product Quality plan (APQP)- human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes Product development economics: Elements of economic analysis, Production part approval process (PPAP) –Feedback assessment and Corrective action- cost evaluation Practical component: Case Studies on Product Design Development, EV car from Concept to Production (A). How would you describe Tesla approach to PD-What are its basic elements- Strengths and weaknesses and how do Tesla manage risks.		CO5 BTL3
TEXT BOOKS		
1	A K Chitale and R C Gupta, Product Design and Manufacturing, 6th Edition, PHI, New Delhi, 2003.	
2	Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, 4 th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9	
REFERENCE BOOKS		
1.	Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education,ISBN 9788177588217	
2.	YousefHaik, T. M. M. Shahin, “Engineering Design Process”, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141	
3	Clive L.Dym, Patrick Little, “Engineering Design: A Project-based Introduction”, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7	
E BOOKS		
1.	https://www.mheducation.com.au/ebook-product-design-and-development-6e-9781307290189-aus	
2.	https://www.taylorfrancis.com/books/mono/10.1201/9780429327803/sustainable-product-design-development-anoop-desai-anil-mital	
3.	https://www.bokus.com/bok/9780077143961/ebook-product-design-and-development/	
MOOC		
1.	https://onlinecourses.nptel.ac.in/noc21_me83/preview	
2.	https://onlinecourses.nptel.ac.in/noc21_de01/preview	

Semester -IV

DEPARTMENT ELECTIVE -2

Specialization 1: ELECTRIC VEHICLE TECHNOLOGY

COURSE TITLE	BATTERY TECHNOLOGY			CREDITS	3
COURSE CODE	EAT51508	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA				ESE	

First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	THEORY	PRACTICAL								
15%	15%	10%	5%	5%	25%	25%								
Course Description	In this course, students will get a complete overview of electrochemistry, Battery terminologies, Battery management system, Charging and discharging for EV application and thermal management.													
Course Objective	1. To discuss on introduction to electrochemical energy storage 2. To interpret the major battery chemistries development and testing 3. To identify the recent developments in batteries 4. To develop advance technology 5. To discuss on batteries for automotive													
Course Outcome	Upon completion of this course, the students will be able to 1. Discuss on introduction to electrochemical energy storage 2. Interpret the major battery chemistries development and testing 3. Identify the recent developments in batteries 4. Develop advance technology 5. Discuss on batteries for automotive vehicles													
Pre-requisite: Nil														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO -2
CO-1	1	-	1	-	-	1	1	-	-	-	1	1	1	2
CO-2	2	-	2	-	-	1	1	-	-	-	2	1	2	1
CO-3	1	-	1	-	-	2	2	-	-	-	1	1	1	2
CO-4	1	-	1	-	-	1	1	-	-	-	2	2	1	1
CO-5	2	-	1	-	-	1	2	-	-	-	1	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 - INTRODUCTION TO ELECTROCHEMICAL ENERGY STORAGE							(6L+ 6P)							
Introduction to battery technologies Electromotive force- Reversible cells- Relation between electrical energy and energy content of a cell-Free energy changes and electromotive force in cell- Current challenges in Energy storage Technologies												CO-1 BTL-3		
Lab Experiments Experiment on Lead Acid Batteries														
MODULE 2 - MAJOR BATTERY CHEMISTRIES DEVELOPMENT AND TESTING							(6L+ 6P)							
Battery performance evaluation- Primary battery - Service time- Voltage data- Service life – ohmic load curve- Effect of operating temperature on service life. Secondary batteries- Discharge curves Terminal voltages- Plateau voltage –Lead acid Batteries – Construction and application.												CO-2 BTL-3		
Lab Experiments Battery testing														
MODULE 3 – RECENT DEVELOPMENTS							(6L+ 6P)							
Recent development of electrode materials in lithium ion batteries- Recent development of solid electrolytes and their application to solid state Batteries-Polymer solid electrolytes for lithium ion conduction.												CO-3 BTL-3		
Lab Experiments Study on Lithium Ion batteries														
MODULE 4 – ADVANCE TECHNOLOGY							(6L+ 6P)							

Thin Film solid state Batteries: Fundamentals, Construction and application – Super Capacitors: Fundamental, Construction and application.		CO-4 BTL-3
Lab Experiments Study on Thin film solid state batteries		
MODULE 5 - BATTERIES FOR AUTOMOTIVE VEHICLES – FUTURE PROSPECTS (6L+ 6P)		
Degrees of vehicle electrification – Battery size vs. application -USABC and DOE targets for vehicular energy storage systems – Analysis and Simulation of batteries - Equivalent circuit and life modeling – Environmental concerns in battery production – recycling of batteries.		CO-5 BTL-3
Lab Experiments Analysis and Simulation of batteries		
Text Books		
1.	T.Minami, M.Tatsumisago, M.Wakihara,C. Iwakura,S. Kohjiya, Solid state ionics for batteries, Springer Publication.	
2.	Sandeep Dhameja, Electric Vehicle Battery Systems, Newnes publication.	
REFERENCE BOOKS		
1	Bard, Allen J., and Larry R. Faulkner. Electrochemical Methods: Fundamentals and Applications. 2nd ed.,Wiley– VCH, Verlag, GmbH.	
2	Masataka Wakihara and Osamu Yamamoto, Lithium ion Batteries Fundamental and Performance, Wiley–VCH, Verlag GmbH.	
3	Robert A.Huggins, Advanced Batteries – Materials science aspects, Springer.	
E Resources for Reference		
1.	https://books.google.co.in/books?id=PznCAAAQBAJ&printsec=frontcover&dq=isbn:9401168814&hl=en&sa=X&ved=0ahUKEwlrKC9sN7ZAhXKQY8KHTrwB1gQ6AEIjAA#v=onepage&q&f=false	
2.	https://books.google.co.in/books?id=PznCAAAQBAJ&printsec=frontcover&dq=isbn:9401168814&hl=en&sa=X&ved=0ahUKEwlrKC9sN7ZAhXKQY8KHTrwB1gQ6AEIjAA#v=onepage&q&f=false	
MOOC		
1.	http://nptel.ac.in/courses/108108076/	
2.	http://nptel.ac.in/courses/108108176/	

COURSE TITLE	ELECTRIC AND HYBRID VEHICLES			CREDITS	3
COURSE CODE	EAT51509	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination
15%	15%	10%	5%	5%	Theory 25% Practical 25%

Course Description	This course will enable the students to gain knowledge about Electric and hybrid vehicles. The electric is the future vehicle doesn't produce and emissions.													
Course Objectives	1. To recall concepts of electric vehicle & performance of electric vehicles. 2. To identify Electric Propulsion Systems & Generators. 3. To recognize on hybrid electric drive train systems. 4. To describe motor controllers and control systems &energy storages. 5. To choose energy Storages on fuel Cells & Solar Cars													
Course Outcomes	Upon completion of this course, the students will be 1. Recall concepts of electric vehicle & performance of electric vehicles. 2. Identify Electric Propulsion Systems & Generators. 3. Recognize on hybrid electric drive train systems. 4. Describe motor controllers and control systems &energy storages. 5. Choose energy Storages on fuel Cells & Solar Cars													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	2	0	0	0	1	0	0	0	0	0	0	0	1	1
CO-2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
CO-3	0	0	0	0	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	0	1	0	0	0	0	0	0	0	1	2
CO-5	0	0	3	0	1	0	0	0	0	0	0	0	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – ELECTRIC VEHICLES													(6L+ 6P)	
Layout of an electric vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system.													CO-1 BTL-3	
Module 2 – ELECTRIC PROPULSION SYSTEMS & GENERATORS													(6L+ 6P)	
DC motors, AC motors, permanent magnet motors, brushless DC and reluctance motors, characteristics, regenerative braking. DC generators, AC generators, voltage and frequency regulations													CO-2 BTL-3	
Module 3 – HYBRID VEHICLES													(6L+ 6P)	
Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design.													CO-3 BTL-3	
Module 4 – MOTOR CONTROLLERS AND CONTROL SYSTEMS&ENERGY STORAGES													(6L+ 6P)	
Control system principles, speed and torque control – DC motors and AC motors. Electromechanical batteries- types of batteries –lead acid batteries, nickel-based batteries, lithium-based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultra-capacitors.													CO-4 BTL-3	
Module 5 – FUEL CELLS & SOLAR CARS													(6L+ 6P)	
Fuel cell, construction, working, equations, possible fuel sources, fuel reformer, design. Solar cars- photovoltaic cells, tracking, efficiency and cost comparison.													CO-5 BTL-4	
TEXT BOOKS														

1.	Longo, Stefano, et al. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles. United States, CRC Press, 2018.
2.	James Larminie and John Lory, "Electric Vehicle Technology-Explained", John Wiley & Sons Ltd., 2013.
REFERENCE BOOKS	
1.	Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680-9567-8.
2.	Tom Denton., "Electric and Hybrid Vehicles"2020.
E BOOKS	
1.	https://shorturl.at/ahvAJ
2.	https://shorturl.at/axzH
MOOC	
1.	https://elearn.nptel.ac.in/shop/iit-workshops/completed/e-mobility-and-electric-vehicle-engineering/
2.	https://nptel.ac.in/courses/108106170

Specialization 2: INTELLIGENT MOBILITY

COURSE TITLE	ADVANCED DRIVER ASSISTANCE SYSTEM			CREDITS	3	
COURSE CODE	EAT51510	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2	
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-4	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments / Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	This course will provide complete knowledge to the undergraduate students on Understanding the Advanced Driver Assistance Systems (ADAS) in general. role of Machine Learning and Deep Learning in ADAS. Role of ADAS towards Autonomous Driving, Sensors used in ADAS and How various ADAS systems are tested in Industry					
Course Objectives	1. To impart the knowledge on Fundamentals of Advanced Driver Assistance Systems (ADAS) 2. To educate about Advanced Driver Assistance Systems 3. To impart the Advanced Driver Assistance Systems 4. To instruct the ADAS Development using Machine Learning and Deep Learning 5. To educate about ADAS systems Testing Techniques and Standards					
Course Outcomes	Upon completion of this course, the students will be able to 1. understand the Fundamentals of Advanced Driver Assistance Systems (ADAS) 2. understand the Advanced Driver Assistance Systems 3. understand the Advanced Driver Assistance Systems 4. understand the ADAS Development using Machine Learning and Deep Learning 5. understand the ADAS systems Testing Techniques and Standards					

Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO-1	3	3	2	2	2	1	1	-	-	-	1	-	3	1
CO-2	3	2	2	3	2	1	-	-	-	-	-	-	3	2
CO-3	2	3	3	2	1	1	1	-	-	-	-	-	2	2
CO-4	2	2	3	2	1	1	-	-	-	-	1	-	3	3
CO-5	3	3	3	3	2	1	-	-	-	-	1	-	2	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Fundamentals of Advanced Driver Assistance Systems (ADAS)													(6L+6P)	
Introduction to ADAS - General Block Diagram – Components of ADAS – need of ADAS - Role of ADAS towards Autonomous Driving - Sensors in ADAS - Automotive Radar - Camera (Vision System) - Ultrasonic Sensor – LIDAR - GNSS, GPS, IMU.													CO-1 BTL-2	
Module 2 – Advanced Driver Assistance Systems													(6L+6P)	
Adaptive Cruise Control (ACC) - Rear Cross Traffic Alert (RCTA)- Vehicle Exit Alert - Front Cross Traffic Alert - Forward Collision Warning - Blind Spot Detection - Parking Assistance System - Intelligent Head Light Control - Occupant Protection System - Pedestrian Protection System- Evasive Steering Support – Vehicle Turn assistance.													CO-2 BTL-2	
Module 3– Advanced Driver Assistance Systems													(6L+6P)	
Traffic sign recognition System - Speed Limit Assist - Lane Departure Warning - 360° surrounding view system - Driver Monitoring System - Driver Drowsiness detection - Emergency Brake Assist - Anti lock braking system - Cross Wind Assist - Tire-pressure Monitoring - Head-Up Display - Navigation													CO-3 BTL-3	
Module 4 – ADAS Development using Machine Learning and Deep Learning													(6L+6P)	
Role of Machine Learning and Deep Learning in ADAS Development - ML & DL in ADAS – Overview - ML & DL in ADAS - Sensors and Sensor Fusion - ML & DL in ADAS – Processors – Algorithms with examples - he supports vector machines (SVM) with histograms of oriented gradients (HOG) and principle component analysis (PCA)- he Bayes decision rule and K nearest neighbor (KNN)													CO-4 BTL-2	
Module 5 – ADAS systems Testing Techniques and Standards													(6L+6P)	
Testing of ADAS - Simulation, SIL, HIL, DIL - Testing of ADAS - On Test Tracks and analysis – Advanced Driver Assistance Systems (ADAS) Calibration- ADAS in functional safety and ISO 262620 standards - Safety Standards – certification policies and Government policies													CO-5 BTL-3	
TEXT BOOKS														
1.	Yan Li, Hualiang Shi “Advanced Driver Assistance Systems and Autonomous Vehicles” Springer; 1st ed. 2022													
2.	Harald Waschl, Ilya Kolmanovsky, Frank Willems, “Control Strategies for Advanced Driver Assistance Systems and Autonomous Driving Functions” Lecture Notes in Control and Information Sciences (LNCIS, volume 476) Springer 2019													
REFERENCE BOOKS														
1.	Amit Kumar Mondal, Lentin Joseph, “Autonomous Driving and Advanced Driver-Assistance Systems (ADAS): Applications, Development, Legal Issues, and Testing” CRC Press; 1st edition 2021													
E BOOKS														
1.	Gerardus Blokdyk “Advanced Driver Assistance Systems (ADAS) Standard Requirements” 5starcooks, January 2021													
MOOC														
1.	https://www.udemy.com/course/advanced-driver-assistance-systems/													

COURSE TITLE	V2V and V2X Technology								CREDITS		3				
COURSE CODE	EAT51511		COURSE CATEGORY			DE			L-T-P-S		2-0-2-2				
VERSION	1.0		APPROVAL DETAILS			36 th ACM			LEARNING LEVEL		BTL-4				
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment		Seminar/ Assignment s/ Project		Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”				Attendance		ESE			
15%		15%		10%		5%				5%		Theory 25%			
												Practical 25%			
Course Description		This course will provide complete knowledge to the undergraduate students on Vehicle to Vehicle (V2V) and Vehicle to Everything (V2X) Communication, 5G V2X Architecture, DSRC Spectrum & Architecture and Connected & Automated Cars													
Course Objectives		1. To impart the knowledge on Fundamentals of Connected Car Technology 2. To educate about DSRC V2X and C- V2X 3. To impart the 5 G V2X Standardization and Architecture 4. To instruct the 5G V2X Operation 5. To educate about V2X Services and Use case													
Course Outcomes		Upon completion of this course, the students will be able to 1. understand the Fundamentals of Connected Car Technology 2. understand the DSRC V2X and C- V2X 3. understand the 5 G V2X Standardization and Architecture 4. understand the 5G V2X Operation 5. understand the V2X Services and Use case													
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
COs		POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO-1		3	3	2	2	2	1	1	-	-	-	1	-	3	1
CO-2		3	2	2	3	2	1	-	-	-	-	-	-	3	2
CO-3		2	3	3	2	1	1	1	-	-	-	-	-	2	2
CO-4		2	2	3	2	1	1	-	-	-	-	1	-	3	3
CO-5		3	3	3	3	2	1	-	-	-	-	1	-	2	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated															
Module 1 – Fundamentals of Connected Car Technology													(6L+6P)		
Vehicle to Vehicle (V2V)– Vehicle to roadway infrastructure (V2I) - Vehicle to Pedestrians (V2P) - Vehicle to the network (V2N) - Vehicle to everything (V2X) – V2X terminology – Vehicle to Cloud (V2C)- V2X Communication Standards – Dedicated Short-Range Communication (DSRC) V2X – Cellular C-V2X.													CO-1 BTL-2		
Module 2– DSRC V2X and C- V2X													(6L+6P)		
DSRC V2X - DSRC Spectrum - DSRC Architecture – DSRC 802.11p – WLAN-based V2X - Wi-Fi - Orthogonal Frequency Division Multiplexing (OFDM) – Carrier Sense Multiple Access (CSMA) - C- V2X Rel.16 based on NR (5G) – Long Term Evolution (LTE) uplink – 3GPP based on cellular modem technology- Single-carrier Frequency Division Multiple Access (SC- FDM) - C-ITS													CO-2 BTL-2		
Module 3– 5 G V2X Standardization and Architecture													(6L+6P)		

Vehicle to everything (V2X) - Intelligent Transportation System Architecture – Sensors – LIDAR and RADAR – ITS Stations – ITS layers – 3GPP NR – V2X Architecture- V2X Application layers - Key 5G nodes for V2X – 5G V2X RSU (Road Side Units) –Multicast broadcast service architecture		CO-3 BTL-3
Module 4– 5G V2X Operation		(6L+6P)
PC5 Configuration – Direct Communication Modes – 5G V2X Bands – Communication Over NR-PC5 – NR-PC5 Protocols – Broadcast – Group Cast - Unicast - NR V2X QoS and Network Slicing – 5G V2X Synchronization - 5G V2X Mobility and Roaming – MEC Traffic Routing and Operation		CO-4 BTL-2
Module 5– V2X Services and Use case		(6L+6P)
V2X telematics – Autonomous Vehicle – 3GPP– 5AA – Safety and Vehicle Management – Cooperative Traffic – Interactive VRU Crossing - Vehicle Management Software – convenience – Automated Valet parking – obstructed view Assistance – Automated Intersection Crossing – Cooperative lane Merge – Infrastructure Assisted Environment Perception – Tele operated Driving – Vehicle Platooning – Patient Transport Monitoring.		CO-5 BTL-3
TEXT BOOKS		
1.	Wishart Jeffrey “Fundamentals of Connected and Automated Vehicles” SAE International,2021	
2.	Fei Hu “Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications” CRC Press 2020	
REFERENCE BOOKS		
1.	Xiang Cheng, Rongqing Zhang, Liuqing Yang “5G-Enabled Vehicular Communications and Networking” Springer 2019	
2.		
E BOOKS		
1.	Radovan Miucic “Connected Vehicles Intelligent Transportation Systems” Springer 2019	
MOOC		
1.	https://www.udemy.com/course/c-v2x-cellular-vehicle-to-everything-5g/	
2.	https://www.udemy.com/course/fundamentals-of-connected-car-technology/	

Specialization 3: ENGINE AND VEHICLE TECHNOLOGY

COURSE TITLE	AUTOMOTIVE POLLUTION AND CONTROL			CREDITS	3
COURSE CODE	EAT51512	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination
15%	15%	10%	5%	5%	Theory 25%
					Practical 25%

Course Description	This course is based on the exposing the students on various automobile emissions and methods to control the automobile pollutants.													
Course Objective	1. To Understand the effect of various types of emissions. 2. To Know about the formation of various types of pollutants from SI and CI engines. 3. To Understand the significance of emission control techniques. 4. To Understand the construction and working of emission measuring instruments. 5. To Learn the various emission standards and test procedures.													
Course Outcome	Upon completion of this course, the students will be able to 1. Familiarize the effect of various automotive emissions. 2. Gain Knowledge about the formation of various types of pollutants from SI and CI engines. 3. Acquire the significance of emission control techniques. 4. Familiarize the construction and working of emission measuring instruments. 5. 5. Gain information on various emission standards and test procedures.													
Prerequisites: Knowledge in fundamentals of Engines														
CO, PO AND PSO MAPPING														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	3	-	-	3	1	2
CO2	3	3	-	2	3	-	-	-	3	-	-	3	1	2
CO3	3	3	-	-	1	-	-	-	3	-	-	3	2	2
CO4	3	3	-	2	-	-	-	-	3	-	-	3	1	3
CO5	3	3	-	-	3	-	-	-	3	-	-	3	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: INTRODUCTION (6L + 6P)														
Vehicle population assessment in metropolitan cities and contribution to pollution, effects on human health and environment, global warming, types of emission, transient operational effects on pollution. Practical component: Emission Measuring Device - Catalogue													CO1 BTL3	
MODULE 2: POLLUTANT FORMATION IN SI ENGINES (6L + 6P)														
Pollutant formation in SI Engines, mechanism of HC and CO formation in four stroke and two stroke SI engines, NO _x formation in SI engines, effects of design and operating variables on emission formation, control of evaporative emission. Two stroke engine pollution. Practical component: Measurement of emissions in SI engines													CO2 BTL3	
MODULE 3: POLLUTANT FORMATION IN CI ENGINES (6L + 6P)														
Pollutant formation in CI engines, smoke and particulate emissions in CI engines, effects of design and operating variables on CI engine emissions. No _x formation and control. Noise pollution from automobiles, measurement and standards. Practical component: Measurement of emissions in CI engines													CO3 BTL3	
MODULE 4: CONTROL OF SI AND CI ENGINES EMISSIONS (6L + 6P)														
Design of engine, EGR, Thermal reactors, secondary air injection, DPF, Lean NO _x , SCR, catalytic converters, catalysts, fuel modifications, fuel cells, Two stroke engine pollution control.													CO4 BTL3	

Practical component: optimum selection of operating variables for control of emissions – Plotting Graph		
MODULE 5: MEASUREMENT TECHNIQUES EMISSION STANDARDS AND TEST PROCEDURE		(6L + 6P)
NDIR, FID, Chemi-luminescent analyzers, Gas Chromatograph, emission standards, driving cycles - USA, Japan, Euro and India. Test procedures - ECE, FTP Tests. SHED Test - chassis dynamometers, dilution tunnels. Practical component: smoke meters – Determination of the emission		CO5 BTL3
TEXT BOOKS		
1	Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2017.	
2	Paul Degobert - Automobiles and Pollution - SAE International ISBN-1-56091-563-3.	
REFERENCE BOOKS		
1.	SAE Transactions- "Vehicle Emission"(3 volumes). .	
2.	Obert.E.F.- "Internal Combustion Engines"	
3.	Marco Nute- " Emissions from two stroke engines, SAE Publication - 1998	
E BOOKS		
1.	Catalysis and Automotive Pollution Control IV (ISSN Book 116) 1st Edition, Kindle Edition	
2.	http://www.faadooengineers.com/threads/9929-Automotive-pollution-and-control-full-notes-ebook-free-download-pdf?s=bec82efb82e4eac385bd1baeef6a5aec	
3.	https://www.scribd.com/book/282540186/Catalysis-and-Automotive-Pollution-Control	
MOOC		
1.	https://nptel.ac.in/courses/103107215	

COURSE TITLE	OFF ROAD VEHICLES			CREDITS	3
COURSE CODE	EAT51513	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 TH ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC"	Attendance	End Semester Examination
15%	15%	10%	5%	5%	Theory 25%
					Practical 25%
Course Description	This course gives knowledge on off road vehicles and its applications				
Course Objectives	1. To familiarize with the construction and working of various Earth moving equipment 2. To acquire the knowledge on construction and working of various constructional equipment 3. To gain knowledge on the construction and working of Farm equipment				

	4. To familiarize with the working of Industrial equipment 5. To develop the knowledge on working of Military equipment													
Course Outcomes	Upon completion of this course, the students will be able to													
	1. Familiarize with the construction and working of various Earth moving equipment													
	2. Acquire the knowledge on construction and working of various constructional equipment													
	3. Gain knowledge on the construction and working of Farm equipment													
	4. Familiarize with the working of Industrial equipment													
5. Develop the knowledge on working of Military equipment														
Prerequisites:														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PS O-2
CO-1	3	1	3	-	-	1	3	-	-	-	2	3	3	1
CO-2	2	1	2	-	-	3	3	-	-	-	1	2	2	2
CO-3	3	2	1	-	-	2	2	-	-	-	2	3	3	2
CO-4	2	1	2	-	-	3	3	-	-	-	1	2	2	1
CO-5	3	1	3	-	-	3	3	-	-	-	1	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 - EARTH MOVING AND MINING EQUIPMENT													(6L+6P)	
Layout of earth moving equipment, capacity and applications of earthmovers like dumpers, front-end loaders, bulldozers, backhoe loaders etc. Rock drilling machines and Excavators. Practice: Demonstration of operation of CAT backhoe loader													CO-1 BTL-2	
MODULE 2 - CONSTRUCTIONAL AND ROAD EQUIPMENT													(6L+6P)	
Layout of Constructional and Road equipment: Tower cranes, hoist, motor graders, Soil Compactors, Road paving machines, concrete ready mixers for construction of bridges and their working principles. Practice: Demonstration of operation of concrete ready mixers.													CO-2 BTL-2	
MODULE 3 - FARM AND FORESTRY EQUIPMENT													(6L+6P)	
Classification of tractors – Main components of tractor. Working of tractors – Auxiliary equipment – Trailers and body tipping mechanism - plowing - paddy plantation machine, harvesting machines, Tree cutting machine. Practice: Demonstration of operation of tractors and implements.													CO-3 BTL-3	
MODULE 4 - INDUSTRIAL EQUIPMENT													(6L+6P)	
Constructional features, capacity and stability of Overhead cranes, Mobile cranes, jib cranes, Forklifts, Towing vehicles. Practice: Demonstration of operation of mobile cranes.													CO-4 BTL-2	
MODULE 5 - MILITARY VEHICLES													(6L+6P)	
Special features and constructional details of tankers, Main Battle Tank(MBT), gun carriers and Military transport vehicles. Practice: Demonstration of operation of Military transport vehicles.													CO-5 BTL-2	
TEXT BOOKS														
1.	Wong.J.T., " Theory of Ground vehicles ", John Wiley & Sons, New York.													
2.	Construction planning, Equipment and Methods - Robert L. Peurifoy, William B. Ledbrtter, Clifford J. Schexnayder - McGrawHill, Fifth Edition.													
REFERENCE BOOKS														
1.	Construction Equipment Management by John Schaufelberger													
2.	Abrosimov. K. Bran berg.A. andKatayer.K., " Road making Machinery ", MIR Publishers, Moscow													
E BOOKS														

1.	https://www.studynama.com/.../construction-techniques-equipment-practices-ebook-n...
2.	https://www.kopykitab.com/Construction-Equipment-and-Job-Planning-eBook
MOOC	
1.	https://www.iti.com/heavy-equipment-training
2.	www.news.mit.edu/2015/mitx-mooc-helps-farmer-develop-autonomous-tractor-app

Specialization 4: DESIGN AND MANUFACTURING

COURSE TITLE		COMPUTER INTEGRATED MANUFACTURING						CREDITS		3				
COURSE CODE		EAT51514		COURSE CATEGORY		DE		L-T-P-S		2-0-2-2				
Version		1.0		Approval Details		36 th ACM		LEARNING LEVEL		BTL-3				
ASSESSMENT SCHEME														
CIA										ESE				
First Periodical Assessment (Theory)		Second Periodical Assessment (Theory)		Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		Theory		Practical		
15%		15%		10%		5%		5%		25%		25%		
Course Description		This course deals with the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.												
Course Objective		1. To discuss on basic concepts of CAD, CAM and computer integrated manufacturing systems 2. To summarize the production planning and control and computerized process planning 3. To differentiate the different coding systems used in group technology 4. To interpret the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system 5. To discuss on robots used in industrial applications												
Course Outcome		Upon completion of this course, the students will be able to 1. Discuss on basic concepts of CAD, CAM and computer integrated manufacturing systems 2. Summarize the production planning and control and computerized process planning 3. Differentiate the different coding systems used in group technology 4. Interpret the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system 5. Discuss on robots used in industrial applications												
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2

CO-1	1	2	1	1	3	1	-	-	2	1	2	1	1	2
CO-2	2	2	2	2	2	2	-	-	3	1	3	2	2	1
CO-3	1	1	1	1	3	-	-	-	2	2	2	1	1	1
CO-4	1	1	2	1	2	-	-	-	3	1	3	2	1	2
CO-5	2	2	1	1	3	-	-	-	2	2	2	1	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: INTRODUCTION													(6L+ 6P)	
Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerized elements of CIM system – Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production. Lab Experiments Experiment on CNC machine													CO-1 BTL-3	
MODULE 2: PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING													(6L+ 6P)	
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems Lab Experiments Practice on Logical steps in Computer Aided Process Planning													CO-2 BTL-3	
MODULE 3: CELLULAR MANUFACTURING													(6L+ 6P)	
Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems Lab Experiments Practice on Group Technology													CO-3 BTL-3	
MODULE 4: FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)													(6L+ 6P)	
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety. Lab Experiments Practice on Quantitative analysis in FMS													CO-4 BTL-3	
MODULE 5: INDUSTRIAL ROBOTICS													(6L+ 6P)	
Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability -													CO-5 BTL-3	

Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems. Lab Experiments Practice on Robot Part Programming		
TEXT BOOKS		
1.	Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2018.	
2.	Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2015.	
REFERENCE BOOKS		
1	Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London.	
2	Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India.	
3	Rao. P, N Tewari & T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Company.	
E Resources for Reference		
1.	https://www.amazon.in/Computer-Integrated-Manufacturing-Venkateshwaran-Alavudeen-ebook/dp/B00K7YFX3S	
2.	https://www.amazon.in/COMPUTER-INTEGRATED-MANUFACTURING-22658-VILAS-ebook/dp/B08B1R2XR3	
3.	https://www.google.co.in/books/edition/COMPUTER_INTEGRATED_MANUFACTURING/GIL0T06n320C?hl=en	
MOOC		
1.	https://onlinecourses.nptel.ac.in/noc22_me10/preview	
2.	https://www.classcentral.com/course/swayam-computer-integrated-manufacturing-17550	

COURSE TITLE	PROCESS PLANNING AND COST ESTIMATION			CREDITS	3
COURSE CODE	EAT51515	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	ESE
15%	15%	10%	5%	5%	Theory 25% Practical 25%
Course Description	To know and understand about the process planning concepts as well as to make cost estimation for various products used in automobiles after process planning				
Course Objectives	1. Define the steps taken to create a process plan for a product. 2. Derive a cost estimation of a product. 3. Define the allocation of overhead costs. 4. Derive the estimation and the cost of castings and forging products. 5. Derive the estimation and the cost of machined products.				

Course Outcomes	Upon completion of this course, the students will be able to 1. Define a Process Plan for a Product. 2. Derive the Cost for a product based on Cost elements for a Product. 3. Assign Overhead cost of the product based on different departments in manufacturing 4. Estimate cost for Casting and Forging products. 5. Estimate the costs for machining a product													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	2	2	2	1	1	1	-	2	-	2	1	1	1
CO-2	2	3	1	2	2	1	2	-	1	-	1	2	1	2
CO-3	3	2	2	1	1	2	1	-	1	-	2	1	2	1
CO-4	1	3	2	2	2	1	2	-	2	-	1	2	1	2
CO-5	3	3	2	1	1	1	1	-	1	-	1	1	1	1
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Process Planning													(6L+6P)	
Process planning –Material selection process– Selection of Production Processes– Selection of Process Parameters– Factors to be considered in selecting: Processes; Process Sequencing; Operation Sequencing; Equipment & Tool Selection; Tool Holding Devices; Measuring Instruments –Computer Aided Process Planning – Types Practical Component: 1.Case Study in Process Planning. 2. Design of Jigs and Fixtures using Auto Cad/Solid works													CO-1 BTL-3	
Module 2 – Cost Estimation													(6L+6P)	
Costing - Cost Estimation – Elements of Cost. Estimating - Functions of Estimating Department, costing versus Estimating, Types, Importance, Procedure of Estimation Practical Component: 1.Calculation of cost for different automobile components													CO-2 BTL-3	
Module 3 – Allocation of Overheads													(6L+6P)	
Overheads, Types - Allocation or Distribution of Overhead Cost , Depreciation and Methods to Calculate it, Interest on Capital, Idleness Costs, Repair and Maintenance Cost													CO-3 BTL-3	
Module 4 – Cost Estimation for Casting, Welding and Forging process													(6L+6P)	
Estimation of cost for Casting processes, Welding processes and Forging processes Practical Component: 1.Estimate the cost of casting an Aluminium Engine block. 2. Create a welding joint (Butt, lap and Tjoint) and estimate the cost involved in the process.													CO-4 BTL-3	
Module 5 – Cost Estimation for Machining process													(6L+6P)	
Estimation of Machining Time and Cost – Lathe operations, Drilling, Milling, Shaping Planing, and Grinding operations. Practical Component: 1.Estimate the cost of turning, facing and threading cutting operations in a lathe 2.Estimate the cost for machining the product (diagram will be provided)													CO-5 BTL-3	
TEXT BOOKS														

1.	Process Planning And Cost Estimation, Panneerselvam, R., Sivasankaran, P.(2016) ISBN: 9788120351721, PHI Learning Pvt. Ltd.
2.	Mechanical Estimating and Costing, T.R. Banga and S.C. Sharma ISBN: 978-81-7409-266-3, Khanna Publishers (2017)
REFERENCE BOOKS	
1.	Narang G.B.S. & Kumar.V, "Production and Costing", Khanna Publishers, 2000.
2.	Process Planning and Cost Estimation 2Nd Edition 2015 by Dr M Adithan, New Age International (P) Ltd Publishers
E BOOKS	
1.	https://www.phindia.com/Books/BookDetail/9788120351721/process-planning-and-cost-estimation-panneerselvam-sivasankaran
2.	https://khannapublishers.in/index.php?route=product/product&path=63&product_id=267
MOOC	
1.	https://in.coursera.org/learn/product-cost-and-investment-cash-flow-analysis
2.	https://nptel.ac.in/courses/112107143

Semester-V

DEPARTMENT ELECTIVE -III

Specialization 1: ELECTRIC VEHICLE TECHNOLOGY

COURSE TITLE		CHARGING TECHNOLOGY						CREDITS			3			
COURSE CODE		EAT51516		COURSE CATEGORY		DE				L-T-P-S			2-0-2-2	
VERSION		1.0		APPROVAL DETAILS		36 th ACM				LEARNING LEVEL			BTL-4	
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)		Second Periodical Assessment (Theory)		Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”				Attendance			ESE	
15%		15%		10%		5%				5%			Theory 25%	
													Practical 25%	
Course Description		The course will focus on the fundamentals of Charging technology for EV vehicles and to understand various underpinning technologies for charger including conductive, wireless and battery swapping.												
Course Objectives		1. To acquire a broad knowledge of battery charging technology. 2. To understand the development of electric vehicle charger from technological, environmental, and societal perspectives.												
Course Outcomes		1. To discuss the basic mechanisms charging of batteries. 2. To interpret the components, processes and characterization tools in battery discharging process. 3. To impart knowledge on fast charging. 4. To deliver knowledge on electric vehicle charging station. 5. To divulge about future and environment aspects.												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO-1	3	3	2	3	2	1	1	1	1	3	3	3	3	3
CO-2	3	3	1	2	1	2	2	1	2	2	2	2	3	3
CO-3	2	2	3	3	3	1	3	2	1	1	1	2	3	3
CO-4	1	2	1	3	2	3	1	2	2	2	1	1	3	3
CO-5	2	1	2	3	3	3	2	2	2	2	2	1	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1- BATTERY CHARGING													(6L+6P)	
Charging NiMH Batteries, Rate of Charge Effect on Charge Acceptance Efficiency of Traction, Battery Packs, Environmental Influences on Charging, Charging Methods for NiMH Batteries, Charging Technology, Battery Pack Corrective Actions. LAB- Observe the charging process, and plot graph of charging/load current-plot graph of charging/load current, SOC, temperature, DOC, and terminal voltage.													CO-1 BTL-3	
Module 2 –BATTERY DISCHARGING													(6L+6P)	
Definition of NiMH Battery Capacity, Discharge Capacity Behavior, Discharge Characteristics of Li-ion Battery, Discharge of an Electric Vehicle Battery Pack, Cold-Weather Impact on Electric Vehicle Battery Discharge LAB-Observe the discharging process, and plot graph of discharging/load current-plot graph of charging/load current, SOC, temperature, DOC, and terminal voltage.													CO-2 BTL-3	
Module 3 – BATTERY FAST CHARGING													(6L+6P)	
On-board & off-board charging, The Fast Charging Process, Fast Charging Strategies, The Fast Charger Configuration, Using Equalizing/Leveling Chargers, Inductive Charging—Making Recharging Easier, Range Testing of Electric Vehicles Using Fast Charging, Electric Vehicle Speedometer Calibration. Wireless Charging LAB- Experiment study on fast charging technology on Li-ion, lead acid batteries.													CO-3 BTL-3	
Module 4 – Electric Vehicles charging station													(6L+6P)	
Type of Charging station, Selection and Sizing of charging station, Components of charging station. Charger infrastructure: Charging station and network, pantograph, load management, Vehicle to Grid, EV Penetration, Synergistic control of EV and planning. LAB- Battery load management studies using MATLAB & Simulink													CO-4 BTL-3	
Module 5 – Future prospects													(6L+6P)	
Charger standards: Wireless standards including Qi, PMA, A4WP, Magnet, conductive charger standard including CHAdeMO, SAE and IEC, Connection and plug. Other Charging technologies: Battery swapping, Hydrogen and solid fuel. Concept of wireless power transfer, Dynamic wireless charger, Coil design, Coupling, Electromagnetic interference. LAB-Case Studies													CO-5 BTL-4	
TEXT BOOKS														
1.	Energy Storage by Robert A. Huggins, Springer Publication													
2.	Sandeep Dhameja, Electric Vehicle Battery Systems, Newnes publication, 2001.													
REFERENCE BOOKS														
1.	Energy storage (A new approach) by Ralph Zito Wiley Publication													
2.	James Larminie and John Lowry, “Electric Vehicle Technology Explained,” John Wiley, 2003.													
E BOOKS														
1.	H. A. Kiehne, “Battery Technology Handbook,” Marcel Dekker, NYC, 2003.													
2.	Energy Management Handbook, Wayne C. Turner, The Fairmont Press Inc., 5th Edition, Georgia.													
3.	Batteries for Sustainable Energy Storage and Conversion" by E. Daniel Perreault													
MOOC														
1.	https://nielit.gov.in/content/online-course-ev-technology-public-charging-station-0													
2.	https://www.my-mooc.com/en/mooc/electric-cars-technology/													
3.	https://www.edx.org/course/electric-cars-technology													

COURSE TITLE		POWER ELECELECTRONICS FOR EV				CREDITS		3							
COURSE CODE		EAT51517		COURSE CATEGORY		DE		L-T-P-S		2-0-2-2					
Version		1.0		Approval Details		36 TH ACM		LEARNING LEVEL		BTL-4					
ASSESSMENT SCHEME															
CIA										ESE					
First Periodical Assessment (Theory)		Second Periodical Assessment (Theory)		Practical Assessmen ts		Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		Theory		Practical			
15%		15%		10%		5%		5%		25%		25%			
Course Description		To introduce the application of electronic devices for conversion, control and conditioning of electric power.													
Course Objective		1. To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics. 2. To familiarize students to the principle of operation, switching techniques and basic topologies power conversion circuits and their applications. 3. To provide strong foundation for further study of power electronic circuits and systems													
Course Outcome		Upon completion of this course, the students will be able to 1. Describe modern power semiconductor devices, their control and protection 2. Design an AC/DC rectifier circuit. 3. Design a DC/DC converter circuit 4. Analyse and design a DC/AC inverter circuit 5. Apply Power Converters in a Power System such as HVDC Transmission and FACTS													
Pre requisites : NIL															
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PS O-1	PS O-2	
CO-1	3	3	2	3	3	-	-	-	-	-	-	1	-	-2	
CO-2	3	3	2	3	3	-	-	-	-	-	-	1	3	2	
CO-3	3	3	2	2	3	-	-	-	-	-	-	1	3	2	
CO-4	3	3	2	3	3	2	2	-	-	-	-	1	3	2	
CO-5	3	3	2	2	-	-	-	-	-	-	-	2	-	2	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: POWER SEMI-CONDUCTOR DEVICES													(6L+6P)		
Structure, operation and characteristics of SCR, TRIAC, power transistor, MOSFET and IGBT-Turn-on and turn-off characteristics and switching losses. Introduction on driver and snubber circuits. Suggested Readings: Advanced semiconductors devices Lab Experiments: 1.Triggering circuits for SCR													CO-1 BTL-3		

2. Obtain the characteristics of MOSFET 3. Obtain the characteristics of IGBT Software/Equipment Required MATLab Simulink		
MODULE 2: PHASE-CONTROLLED CONVERTERS		(6L+ 6P)
2-pulse, 3-pulse and 6-pulse converters - Inverter operation of fully controlled converter - Effect of source inductance - Distortion and displacement factor - Ripple factor - Single phase AC voltage controllers. Suggested Reading: THD, types of filters, firing circuit design. Lab Experiments: 1.Analyse the operation of single phase full wave controlled rectified with R-L load 2 Analyse the operation of three phase full wave controlled rectified with R-L load Software/Equipment Required MATLab Simulink and High voltage power electronics work bench		CO-2 BTL-3
MODULE 3: DC TO DC CONVERTERS		(6L+ 6P)
Step-down and step-up choppers - Time ratio control and current limit control - Switching mode regulators: Buck, boost, buck-boost and Cuk converter Suggested Reading: Simulation of various choppers using MATLAB Lab Experiments: 1.Design a Buck-boost regulator and plot the characteristics for different duty cycle 2. Design a cuk converter and plot the characteristics for different duty cycle Software/Equipment Required MATLab Simulink and High voltage power electronics work bench		CO-3 BTL-4
MODULE 4: INVERTERS		(6L+ 6P)
Single phase and three phase (both 120degree mode and 180 mode) inverters - PWM techniques: Sinusoidal PWM, modified sinusoidal PWM and multiple PWM - Series resonant inverter - Current source inverters. Lab Experiments: 1.IGBT based single-phase bridge inverter 2. MOSFET or IGBT based single-phase series-resonant inverter. Software/Equipment Required MATLab Simulink, and High voltage power electronics work bench		CO-4 BTL-4
MODULE 5: APPLICATIONS		(6L+ 6P)
Uninterrupted power supply topologies - Flexible AC transmission systems - Shunt and series static VAR compensator - Unified power flow controller- HVDC Transmission. Suggested Readings: Application of UPS, UPFC		CO-5 BTL-4
BOOKS		
1.	Muhammad H. Rashid, " <i>Power Electronics: Circuits, Devices and Applications</i> ", Pearson Education, Third edition, 2017 .	
2.	P.S.Bimbora, , " <i>Power Electronics</i> ", Khanna Publications, fifth edition", 2022.	
REFERENCE BOOKS		
1	Mohan, N., T. M. Undeland, and W. P. Robbins. "Power Electronics book: Converters." 2019.	

2	Rashid, Muhammad H., ed. "Power electronics handbook", Butterworth-heinemann, 2017.
E Resources for Reference	
1.	www.powerelectronics.com/learning-resources/ebooks
2.	https://www.scribd.com/document/356197939/Power-Electronics-Book
MOOC	
1.	https://www.coursera.org/learn/power-electronics

Specialization 2: INTELLIGENT MOBILITY

COURSE TITLE		ECU MODEL BASED SYSTEM DESIGN				CREDITS		3						
COURSE CODE	EAT51518	COURSE CATEGORY	DE		L-T-P-S		2-0-2-2							
Version	1.0	Approval Details	36 th ACM		LEARNING LEVEL		BTL-3							
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessment	Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		ESE							
15%	15%	10%	5%		5%	Theory 25%								
						Practical 25%								
Course Description	This course provides concepts of ECU design for automotive applications, knowledge on software modules and hardware modules for ECU design.													
Course Objectives	1. To familiarize on concepts of ECU design for automotive applications. 2. To gain knowledge on software modules and hardware modules for ECU design 3. To acquire knowledge to solve complex problems in Model based system design & hardware in-the-loop simulation 4. To attain the knowledge on the process of Verification and 5. To develop Validation of HIL test results with real world result Hardware in-the-Loop testing.													
Course Outcomes	Upon completion of this course, the students will be able to 1. Familiarize on concepts of ECU design for automotive applications. 2. Gain knowledge on software modules and hardware modules for ECU design 3. Acquire knowledge to solve complex problems in Model based system design & hardware in-the-loop simulation 4. Attain the knowledge on the process of Verification and 5. Develop Validation of HIL test results with real world result Hardware in-the-Loop testing.													
Prerequisites: NIL														
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PS O-1	PS O-2

CO-1	3	1	3	-	-	1	3	0	-	-	0	3	2	1
CO-2	2	1	2	-	-	3	3	0	-	-	1	2	2	3
CO-3	3	2	1	-	-	2	2	0	-	-	2	3	1	2
CO-4	2	1	2	-	-	3	3	0	-	-	1	2	2	1
CO-5	3	1	3	-	-	3	3	0	-	-	1	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 – ECU DESIGN CONCEPT													(6L+6P)	
The concepts of ECU design for automotive applications- Need for ECUs- advances in ECUs for automotive- design complexities of ECUs-V-Model for Automotive ECU 's Architecture of an advanced microcontroller used in the design of automobile ECUs -analog and digital Interfaces- Controllers for ECUs: Understanding different ECUs in an automobile-challenges and design requirements of ECU design - selection of sensors and interfaces for ECU design.													CO-1 BTL-2	
MODULE 2 – MATHEMATICAL MODELING AND VALIDATION													(6L+6P)	
Top level blocks diagram development for ECUs- design of software modules and hardware modules for ECU design- mathematical modeling of automotive Applications-Designing- modelling and porting of software models on ECUs-development of test setup for ECU testing- System level testing: Experimental setup for ECU validation-system level optimization for cost-reliability check and endurance check of ECUs- signal integrity check and EMI/EMC analysis- integration of ECUs into automotive.													CO-2 BTL-2	
MODULE 3– MODEL BASED SYSTEM DESIGN													(6L+6P)	
Introduction to Model based system design -hardware in-the-loop simulation- continuous and discrete simulation basics-modeling basics. Connection between Hardware and Simulation- Coupling concepts-simulator coupling and co-simulation, synchronization of co-simulations, basic coupling principles- Event Discrete Simulation-Real Time Workshop-Introduction to basic Simulink blocks, xPC target, Real Time Workshop-State flow and Real Time Embedded coder.													CO-3 BTL-3	
MODULE – 4 MODEL BUILDING WITH SIMULINK													(6L+6P)	
Model Building with Simulink: Controller programming using model based system design for an automotive application using Simulink-Plant Modelling- Plant modelling using Simulink for the automotive application-PID controller design, analog output, targeting a processor for plant- Hardware Implementation-Design of ECU for automotive applications, interfacing of sensors and Actuators-System modelling and validation using test setup- Interfacing of software models with hardware design.													CO-4 BTL-2	
MODULE- 5 HARDWARE IN LOOP SIMULATION													(6L+6P)	
System programming and development of experimental setup for hardware in loop simulation. Hardware in-the-Loop-Testing of plant separately, testing of controller separately and testing of plant and controller in the loop-System Verification and Validation-Comparing the HIL test results with real world result Hardware in-the-Loop testing- Experimental setup for HIL-HIL testing using dSPACE micro autobox, introduction to carmaker, building scenarios and vehicle analysis using carmaker- interfacing dSPACE with carmaker and case studies on micro autobox													CO-5 BTL-2	
TEXT BOOKS														

1.	Frank Vahid and Tony Givargis, (2002) Embedded System Design: A Unified Hardware/Software Introduction, John Wiley & Sons Ronald K. Jurgen,(1999), Automotive Electronics Handbook, McGraw-Hill .
2.	Heywood, John B. (2018) Internal Combustion Engine Fundamentals, McGraw-Hill, New York.
3.	Hall, Douglas V, (2015) Microprocessors and Interfacing: Programming and Hardware, 2nd edition, Tata McGraw Hill
REFERENCE BOOKS	
1.	David E. Simon, (2015), An Embedded Software Primer, Pearson Education
2.	Ferguson, Colin R. (2010) Kirkpatrick, Allan T., Internal Combustion Engine - Applied
E BOOKS	
1.	http://estc.dsr-company.com/images/b/b5/Automotive-embedded-systems.pdf
MOOC	
1.	https://nptel.ac.in/courses/108103009/download/M10.pdf

COURSE TITLE	CYBER SECURITY FOR AUTOMOTIVE ENGINEERS			CREDITS	3	
COURSE CODE	EAT51519	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2	
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3	
ASSESSMENT SCHEME						
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination	
					Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	This course will enable the students to explore the various cyber-attacks, practice the security tools and employ penetration testing.					
Course Objectives	1. To outline the key components and principles of security. 2. To explore the various attacks and management roles 3. To apply the security policies and procedures for organizations 4. To practice the security tools and hardening techniques 5. To employ the penetration testing.					

Course Outcomes	Upon completion of this course, the students will be able to														
	1. Outline The Key Components and Principles of Security														
	2. Explore The Security Attacks and Management Roles.														
	3. Apply the cyber security policies and procedures for organizations.														
	4. Practice The Security Tools and Hardening Techniques														
5. Employ the Penetration Testing and explore the Next Generation Security.															
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	
CO-1	3	3	2	2	2	2	-	2	2	2	2	2	1	1	
CO-2	3	3	2	2	2	2	-	2	2	2	2	2	2	1	
CO-3	3	3	2	2	2	2	-	2	2	2	2	2	3	3	
CO-4	3	3	2	2	2	2	-	2	2	2	2	2	2	2	
CO-5	3	3	2	2	2	2	-	2	2	2	2	2	3	3	
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated															
MODULE 1: INTRODUCTION TO CYBERSECURITY														(6L+ 6P)	
Introduction to Cyber Security, Need for security, Concept of Cyber Space, Cyber Crimes and Cyber-attack. Fundamental security principles –threats, attacks and vulnerability. Key Security triad–Confidentiality, Integrity and Availability. Key components of cyber security network architecture. Introduction to basic Security Management and Policies- Authentication, Authorization, Access control, Identification and Accounting.														CO-1 BTL-3	
Lab Experiment															
Detection of various cyber-attacks using Wireshark.															
Software Tool :Wireshark.															
MODULE 2: SECURITY ATTACKS, PRINCIPLES AND MANAGEMENT														(6L+ 6P)	
Introduction to different classes of security attacks - active and passive. Impact of attacks on organization and individuals. Principles of Cybersecurity - Apply cybersecurity architecture principles. Cyber security models (the CIA triad, the star model, the Parkerian hexad).														CO-2 BTL-3	
Techniques used by Hackers - The Reconnaissance Phase: Active and Passive Scanning Techniques. Risk Management–Principles, Types Strategies-The Risk Management Framework(RMF). Cyber security Management concepts – Security Governance and Management roles, models and functions.															
Lab Experiment															
Packet sniffing using Wireshark.															
Software Tool :Wireshark.															
MODULE 3: SECURITY PLANS,POLICIES AND PROCEDURES														(6L+ 6P)	

Defining a Cyber Security policy, General Security Expectations, roles and responsibilities in the organization– Stakeholders. Cyber security standards and controls - Certification and accreditation (C&A) process. Audit goals -Updating and auditing cyber security procedures -Compare the organization's cyber security policy to actual practices.		CO-3 BTL-3
Lab Experiment Managing Securing Policies Using Tcp dump, dump cap using Wireshark. Software Tool :Wireshark.		
MODULE 4: OVERVIEW OF SECURITY COUNTER MEASURE TOOLS		
Introduction to key security tools including firewalls, anti-virus and cryptography – Identify security tools and hardening techniques–Prevention of Cyber-attacks. Security Countermeasure tools and techniques - Encryption standards - Modern Methods – Legitimate versus Fraudulent Encryption Methods. Security threats–Threat and Risk exposure -Determine the organization's exposure to internal threats –Evaluate the risk of external security threats. Lab Experiment Security analysis and reporting using Wireshark. Software Tool :Wireshark.		CO-4 BTL-3
MODULE 5: CYBERSECURITY TESTING,DIGITAL FORENSICS AND NEXT GENERATION SECURITY		
Cybersecuritytesting–Penetrationtesting.SystemLevelSolutions-IntrusionDetectionSystem(IDS)andIntrusionProtectionSystem(IPS). Basic Concept of Ethical Hacking. Protecting against Cyber Crime–Identity Theft, Cyber Stalking and Investment fraud. Introduction to digital forensics - Digital Forensics Tools and Forensics Investigative Process. Introduction to Next-Generation Firewall – Preventing Infection and Finding Infected Hosts. Smart Policies for ensuring security. Lab Experiment Pen Test (Penetration Testing) using Wireshark. Software Tool :Wireshark.		
TEXT BOOKS		
1.	Lawrence C. Miller, “Cyber security for Dummies” -PaloAl to Networks, by John Wiley & Sons, Inc., 2 nd Edition, 2016.	
2.	William Stallings, “Effective Cyber security: A Guide to Using Best Practices and Standards”, Addison-Wesley Professional Publishers, 1 st Edition, 2018.	
REFERENCE BOOKS		
1.	Raef Meeu wisse,“ Cyber security for Beginners”, Cyber Simplicity Publications, 2 nd Edition, 2017.	
2.	Mehdi Khosrow-Pour, DBA, Information Resources Management Association, USA, “Cyber security and threats: concepts, methodologies, tools, and applications”, IGI Global, Vol. 1, 2018.	

E BOOKS	
1.	http://www.uou.ac.in/sites/default/files/slm/Introduction-cyber-security.pdf
MOOC	
1.	https://www.edx.org/course/cybersecurity-fundamentals
2.	https://www.coursera.org/specializations/cyber-security
3.	https://www.udemy.com/topic/cyber-security/

Specialization 2: ENGINE AND VEHICLE TECHNOLOGY

COURSE TITLE		VEHICLE DESIGN DATA CHARACTERISTICS						CREDITS			3			
COURSE CODE		EAT51520		COURSE CATEGORY			DE		L-T-P-S			2-0-2-2		
Version		1.0		Approval Details			36 TH ACM		LEARNING LEVEL			BTL-3		
ASSESSMENT SCHEME														
CIA											ESE			
First Periodical Assessment (Theory)		Second Periodical Assessment (Theory)		Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		THEORY		PRACTICAL		
15%		15%		10%		5%		5%		25%		25%		
Course Description		This course involved in the vehicle design and apply the data for the optimum designing of the vehicle components												
Course Objective		To make the students understand the basic principles involved in the vehicle design and apply the same for the optimum designing of the vehicle components.												
Course Outcome		Upon completion of this course, the students will be able to 1. Discuss on vehicle specifications 2. Interpret on performance curves 3. Determination of resistance to vehicle motion 4. Design of Engine 5. Determination of gear ratios												
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	2	-	-	-	-	-	2	1	2	2	3

CO-2	2	3	3	2	-	-	-	-	-	1	2	3	3	3
CO-3	3	2	2	3	-	-	-	-	-	2	1	2	2	3
CO-4	2	2	3	2	-	-	-	-	-	2	1	3	2	3
CO-5	3	3	2	3	-	-	-	-	-	2	1	2	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: INTRODUCTION													(6L+ 6P)	
Study and selection of vehicle specifications - Choice of Cycle, fuel, speed, cylinder arrangement, number of cylinders, method of cooling, material, design variables and operating variables affecting performance and emission. Lab Experiments 1. Practice on selection of vehicle specifications and study													CO-1 BTL-3	
MODULE 2: PERFORMANCE CURVES													(6L+ 6P)	
Resistance, Power and torque curve, driving force against vehicle speed – Acceleration and gradeability in different gears for a typical car or truck plotted from specifications. Lab Experiments 1. Calculation of Resistances, power and torque													CO-2 BTL-3	
MODULE 3: RESISTANCE TO VEHICLE MOTION													(6L+ 6P)	
Calculation and plotting the curves of air, rolling and gradient resistances, driving force – Engine power, speed, rear axle ratio, Torque and mechanical efficiency at different vehicle speeds. Lab Experiments 1. Calculation of driving force, engine power													CO-3 BTL-3	
MODULE 4: ENGINE DESIGN													(6L+ 6P)	
Pressure volume diagram, frictional mean effective pressure, engine capacity, calculation of bore and stroke length, velocity and acceleration, gas force, inertia and resultant force at various crank angles – Side thrust on cylinder walls. Lab Experiments 1. Practice to calculate gas force, inertia and resultant force at various crank angles													CO-4 BTL-3	
MODULE 5: GEAR RATIOS													(6L+ 6P)	
Determination of Gear Ratios, Acceleration and gradeability - typical problems. Lab Experiments 1. Calculation of gear ratios													CO-5 BTL-3	
TEXT BOOKS														
1.		Giri.N.K. “Automobile Mechanics” Khanna Publishers – New Delhi .												
2.		Heldt P.M “High Speed Combustion Engine” Oxford & IBH Publishing Co., Calcutta.												
REFERENCE BOOKS														
1		Lichty “IC Engines”, Kogakusha Co., Ltd. Tokyo												
E Resources for Reference														
1.		https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAU1404.pdf												

COURSE TITLE		DESIGN OF ENGINE EXHAUST SYSTEM						CREDITS		3				
COURSE CODE		EAT51521		COURSE CATEGORY		DE		L-T-P-S		2-0-2-2				
Version		1.0		Approval Details		36 th ACM		LEARNING LEVEL		BTL-3				
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)		Second Periodical Assessment (Theory)		Practical Assessment		Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		ESE				
15%		15%		10%		5%		5%		Theory 25%				
										Practical 25%				
Course Description		This course gives knowledge in the global environmental air pollution control bureaus, emission control systems and noise control devices and advanced technology development on exhaust system for SI and CI engines.												
Course Objectives		1. To gain knowledge in the global environmental air pollution control bureaus 2. To familiarize with emission control systems and noise control devices 3. To design and validate full exhaust system for on-road, off-road and non-road applications. 4. To gain knowledge on the advanced technology development on exhaust system for SI and CI engines 5. To familiarize with automobile design and computational simulation environments												
Course Outcomes		Upon completion of this course, the students will be able to 1. Gain knowledge in the global environmental air pollution control bureaus 2. Familiarize with emission control systems and noise control devices 3. Design and validate full exhaust system for on-road, off-road and non-road applications. 4. Gain knowledge on the advanced technology development on exhaust system for SI and CI engines 5. Familiarize with automobile design and computational simulation environments												
Prerequisites:														
CO, PO AND PSO MAPPING														
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PS O-1	PS O-2
CO-1	2	1	1	2	1	-	-	-	-	-	-	1	1	1
CO-2	1	2	2	1	0	-	-	-	-	-	-	2	2	0
CO-3	2	1	1	1	2	1	-	-	-	-	-	1	0	2
CO-4	2	0	0	0	1	-	-	-	-	-	-	1	1	2
CO-5	0	0	3	0	1	-	-	-	-	-	-	2	3	3

1: Weakly related, 2: Moderately related and 3: Strongly related	
MODULE 1 - INTRODUCTION TO ENGINE EXHAUST	
Introduction of exhaust system – Engine Exhaust Technology Evolution – India automotive emission regulation – Noise limits for vehicles at manufacturing stage – Basics of Exhaust System from Engine head face to tail pipe – Components of exhaust system – Exhaust catalytic converter – Silencer (Muffler) – System integration. Suggested Reading: IC engine exhaust, Layout of IC engine systems.	CO-1 BTL-2
MODULE 2 - EMISSION CONTROL SYSTEMS	
Understanding of Gasoline and diesel engine out pollutants – Emission Norms – Air to Air – Converter Hot end components – TWC – Manifold – Cone Profiles – Substrate – Types of Substrate – Wash coat – Mat – Types of Mats – Shell – Canning – Types of Canning – Controlled canning – GBD (Gab Bulk Density) – Temperature Sensor – Oxygen Sensor – Thermal Management – Insulators – Heat Shields – (Gasoline / Diesel) – Advancement in substrates – Technology for gasoline engine – Three way converter (TWC) – Gasoline particulate filter (GPF) – Lean NOx Trap (LNT) – Technology for diesel engine – Exhaust gas recirculation (EGR) – Diesel oxidation catalyst (DOC) – Partial flow filter (PFF) – Diesel particulate filter (DPF) – Selective catalytic reduction (SCR) – Selective catalytic reduction filter (SCRF) – Global regulations and testing protocols – System integration. Carbon di oxide (CO₂) control systems. Suggested Reading: carbon di oxide emissions	CO-2 BTL-3
MODULE 3 - NOISE CONTROL SYSTEMS	
Basics of Acoustics – Fundamentals of sound – Terminologies – Noise cancellation – Destructive & Constructive interferences – Engine exhaust noise introduction – Gasoline & Diesel engine operation & exhaust noise characteristics – Vehicle Pass by Noise – Exhaust noise measurement standards – Types of exhaust noises – Pulsation noises – Flow noises – Booming noises – Shell radiation noises – Passive noise reduction techniques – Types of mufflers – Reflective – Absorptive Hybrid mufflers – Muffler design constrains – Muffler internal design – Tri flow muffler – Straight though muffler – Helmholtz resonator – Internal resonators – Baffle plates – Perforations – shells – End Plates – Pipe diameters – Absorptive materials – Development methodologies – Muffler performance parameters – Sound transmission loss – Insertion loss – Noise reduction – Tail pipe noise level – back pressure – Vehicle interior noise levels – Advanced muffler technologies – Cat con integrated muffler – variable flow muffler – Twin mufflers – Active noise cancellation – Sporty sound mufflers – Sound engineering, Off Road – On Road – Non Road muffler applications Examples – Manufacturing Types & Process – Roll & Spot welding – Lock seaming – Double seaming – Web forming – Clinching – Cold metal transfer – Hydro forming – Piercing – Stamping – Muffler examples. Suggested Reading: Muffler design	CO-3 BTL-3
MODULE 4 - COMPUTATIONAL ANALYSIS (CFD, FEA)	
(6L+6P)	

CFD for vehicle exhaust system – Governing equation of fluid flow and heat transfer – Flow Uniformity – Pressure loss through exhaust system – Flow Eccentricity – HEGO Index – Conjugate Heat Transfer Analysis – Introduction to finite element analysis.Present, Past, Future FEA – Introduction to Pre-processing ID, 2D, 3D Elements – Meshing, Processing Techniques – Statics of strength of materials – Types of Analysis – Modal Analysis – Linear Static Analysis – Introduction to Non-linear Analysis – Dynamic Analysis – Thermal Analysis – RLDA & Fatigue Analysis – Post processing techniques of different Analysis – Process Flows and Targets – Case Study 1-2-3. Suggested Reading: Finite element analysis		CO-4 BTL-3
MODULE 5 - TESTING AND VALIDATION (6L+6P)		
Vehicle noise measurement – Operational vibration analysis – Experimental modal analysis – Air leak test Thermal Shock Tests – Thermal fatigue test – Back pressure measurement test – Hot end system: Hot Vibration Test – Cold vibration test – Flow noise measurement – Shell deformation test – Cold end: Biaxial fatigue test – Uni-axial fatigue test – Salt spray test – Condensate Water Noise Test – Transmission loss measurement – Shell stiffness measurement – Glass wool endurance test – Resonance frequency measurement – Shell radiation noise measurement – Tail pipe noise measurement – Water drainage ability test. Suggested Reading: Automotive testing		CO-5 BTL-3
TEXT BOOKS		
1.	Engine Emissions: Pollutant Formation and Advances in Control Technology, Alpha science publisher,2015	
2.	Noise and Bivration Control Engineering (Principles and applications) Istvan L. Ver and Leo L, 2016.	
REFERENCE BOOKS		
1.	Beranek, - 2nd Edition 2006, John Wiley & Sons Inc	
2.	Acoustics of Ducts and Mufflers with Applications to Exhaust and Ventilation System Design, M.L. Munjal – 2ndEdition, Wiley – Inter Science.	
MOOC		
1.	https://www.youtube.com/watch?v=W6dIsC_eGBI	

Specialization: Design and Manufacturing

COURSE TITLE	DIGITAL MANUFACTURING			CREDITS	3
COURSE CODE	EAT51522	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE
15%	15%	10%	5%	5%	Theory 25%
					Practical

														25%
Course Description	This course provides knowledge on prototyping and 3D printing, CAD and reverse engineering & powder based additive manufacturing systems.													
Course Objectives	1. To discuss on need for digital manufacturing 2. To acquire knowledge on prototyping and 3D printing 3. To develop skill on CAD and reverse engineering 4. To familiarize on liquid based and solid based additive manufacturing systems 5. To acquire knowledge on powder based additive manufacturing systems													
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on need for digital manufacturing 2. Acquire knowledge on prototyping and 3D printing 3. Develop skill on CAD and reverse engineering 4. Familiarize on liquid based and solid based additive manufacturing systems 5. Acquire knowledge on powder based additive manufacturing systems													
Prerequisites:														
CO, PO AND PSO MAPPING														
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PS O-1	PS O-2
CO-1	3	1	2	2	3	-	-	-	-	-	-	3	3	1
CO-2	2	2	1	1	3	-	-	-	-	-	-	2	2	2
CO-3	3	2	2	2	1	-	-	-	-	-	-	3	3	2
CO-4	2	1	1	1	3	-	-	-	-	-	-	2	2	1
CO-5	3	1	1	1	2	-	-	-	-	-	-	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 - NEED FOR DIGITAL MANUFACTURING													(6L+6P)	
Introduction to Future Manufacturing: three – legged stool concept, Definition of DM, Need for DM, 10 disruptive principles of DM process, SM Vs DM Suggested Reading: Modern manufacturing processes.													CO-1 BTL-2	
MODULE 2 – PROTOTYPING													(6L+6P)	
Introduction to 3D printer, Role of 3D in product development, Classification of 3D Printer Technology. Suggested Reading: Advantages of 3D printing.													CO-2 BTL-2	
MODULE 3 - CAD & REVERSE ENGINEERING													(6L+6P)	
Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Basic Software for Additive Manufacturing Technology: MIMICS, MAGICS.													CO-3 BTL-3	

Suggested Reading: CAM and its merits		
MODULE 4 - LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS (6L+6P)		
Classification – Liquid based system – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing Suggested Reading: Additives and its applications.		CO-4 BTL-2
MODULE 5 - POWDER BASED ADDITIVE MANUFACTURING SYSTEMS (6L+6P)		
Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three-Dimensional Printing – Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting. Suggested Reading: Powder based additives.		CO-5 BTL-2
TEXT BOOKS		
1.	Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third Edition, World Scientific Publishers, 2010.	
2.	Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2012.	
REFERENCE BOOKS		
1.	Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2010.	
2.	Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2016.	
E BOOKS		
1.	www.springer.com/gp/book/9780857295637	
2.	https://pro.sculpteo.com/en/ebooks/	
MOOC		
1.	https://www.coursera.org/specializations/digital-manufacturing-design-technology	
2.	https://www.coursera.org/learn/digital-manufacturing-design	

COURSE TITLE	INDUSTRIAL AUTOMATION AND ROBOTICS			CREDITS	3
COURSE CODE	EAT51523	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination
15%	15%	10%	5%	5%	Theory 25% Practical 25%
Course Description	This course enables the necessary automation with respect to the type of industry, size and the capacity of the industry per stipulated period. The application, advantages and limitations of the methods of automation requirement for the specific type of industry. Application of				

	Robotics for the required industry to decrease the work load and the activity time consumption of the industries.													
Course Objectives	1. To develop the student's knowledge in various robot structures and their workspace. 2. To develop student's skills in performing spatial transformations associated with rigid body motions and robot systems. 3. To provide the student with knowledge of the singularity issues associated with the operation of robotics systems. 4. To provide the student with some knowledge and analysis skills associated with trajectory planning and robot control. 5. To develop the analytical ability for the robotics for the necessity of the industries.													
Course Outcomes	Upon completion of this course, the students will be able to 1. Demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics. 2. Apply spatial transformation to obtain forward kinematic equation of robot manipulators. 3. Analyze for solving inverse kinematics of simple robot manipulators. 4. Develop an ability to obtain the Jacobean matrix and use it to identify singularities 5. Create the design, model and apply the concepts through robotics to the necessary application in the industries													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO-1	3	3	3	3	2	2	2	2	1	1	1	1	3	3
CO-2	3	3	3	3	2	2	2	2	1	1	1	1	3	3
CO-3	3	3	3	3	2	2	2	2	1	1	1	1	3	3
CO-4	3	3	3	3	2	2	2	2	1	1	1	1	3	3
CO-5	3	3	3	3	2	2	2	2	1	1	1	1	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction													(6L+6P)	
Concept and scope of automation: Socio economic impacts of automation, Types of Automation, Low Cost Automation.													CO-1 BTL-3	
Module 2 – Fluid Power													(6L+6P)	
Fluid power control elements, Standard graphical symbols, Fluid power generators, Hydraulic and pneumatic Cylinders - construction, design and mounting; Hydraulic and pneumatic Valves for pressure, flow and direction control.													CO-2 BTL-3	
Module 3 – Basic hydraulic and pneumatic circuits													(6L+6P)	
Direct and Indirect Control of Single/Double Acting Cylinders, designing of logic circuits for a given time displacement diagram & sequence of operations, Hydraulic & Pneumatic Circuits using Time Delay Valve & Quick Exhaust Valve, Memory Circuit & Speed Control of a Cylinder, Troubleshooting and “Causes & Effects of Malfunctions” Basics of Control Chain, Circuit Layouts, Designation of specific Elements in a Circuit.													CO-3 BTL-3	
Module 4 – Fluidics, Electrical and Electronic Controls and Transfer Devices and feeders													(6L+6P)	
Boolean algebra, Truth Tables, Logic Gates, Coanda effect. Basics of Programmable logic controllers (PLC), Architecture & Components of PLC, Ladder Logic Diagrams. Classification, Constructional details and Applications of Transfer devices, Vibratory bowl feeders, Reciprocating tube, Centrifugal hopper feeders.													CO-4 BTL-3	
Module 5 – Robotics													(6L+6P)	

Introduction, Classification based on geometry, control and path movement, Robot Specifications, Robot Performance Parameters, Robot Programming, Machine Vision, Teach pendants, Industrial Applications of Robots.		CO-5 BTL-4
TEXT BOOKS		
1.	Esposito, Anthony. <i>Fluid power with applications</i> . Upper Saddle River, New Jersey: Prentice Hall, 2000.	
2.	Vacca, Andrea, and Germano Franzoni. <i>Hydraulic fluid power: fundamentals, applications, and circuit design</i> . John Wiley & Sons, 2021.	
REFERENCE BOOKS		
1.	Yeaple, Frank. <i>Fluid power design handbook</i> . CRC Press, 1995.	
2.	Zhang, Qin. <i>Basics of hydraulic systems</i> . CRC Press, 2019.	
E BOOKS		
1.	Fluid Power eBook, Edition 1	
2.	El-Din, Mahmoud Galal, and Mohamed Rabi. <i>Fluid power engineering</i> . McGraw-Hill Education, 2009.	
3.	Watton, John. <i>Modelling, monitoring and diagnostic techniques for fluid power systems</i> . Springer Science & Business Media, 2007.	
MOOC		
1.	https://archive.nptel.ac.in/courses/112/106/112106175/	
2.	https://archive.nptel.ac.in/courses/112/106/112106300/	
3.	https://archive.nptel.ac.in/courses/112/105/112105047/	

Semester –VI

Department Elective-4

Specialization 1: Electric Vehicle Technology

COURSE TITLE	MODELLING AND SIMULATION EV			CREDITS	3	
COURSE CODE	EAT51524	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2	
Version	1.0	Approval Details	36 TH ACM	LEARNING LEVEL	BTL-4	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessment	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	This course introduces the architectures and technologies associated with electric, hybrid electric, and plug-in hybrid vehicles including their constituent components					
Course Objective	1. To understand the basic components and various types of electric vehicles 2. To familiarize the different types of motors used in electric vehicles 3. To discuss about the battery technology for electric vehicles 4. To familiarize the different charging system technologies for electric vehicles 5. To discuss about the future trends in electric vehicles.					
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the architecture design of electric vehicle and types of electric vehicles 2. Select appropriate electric machine for electric vehicle application. 3. Demonstrate the battery management system for electric vehicles.					

		4. Describe the different types and design considerations of electric vehicle charging. 5. Illustrate the recent trends and developments in electric vehicle market													
Prerequisites: NIL															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PS O-2	
CO-1	3	3	3	3	3	-	-	-	-	-	-	-	1	-	
CO-2	3	3	3	3	3	-	-	-	-	-	-	-	1	1	
CO-3	3	3	3	3	3	-	-	-	-	-	-	-	1	1	
CO-4	3	3	3	3	3	-	1	-	-	-	-	-	1	1	
CO-5	3	3	3	3	3	-	1	-	-	-	-	-	1	1	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO TECHNOLOGY OF EVs														(6L+6P)	
Basic EV Components and Architecture - Types of electric vehicles - Basics of EV charging - Case study Suggested Reading: Economies of Electric Vehicles compared to gasoline vehicles Lab Experiments: 1.Study of various components of electric car. 2. Electric Vehicle Architecture Design. Software Required: MATLAB													CO-1 BTL-4		
MODULE 2: ELECTRIC MOTORS FOR EVs														(6L+ 6P)	
Electric Motor Requirements for EV's - Application of PMSM & BLDC Motor for EV's - Application of Induction & Switched Reluctance Motor Technology for EV's - Thermal Management of EV Motors - Sensing Requirements for EV Motors Suggested Reading: DC Machine Drives and Control of EV Using DC Machine Lab Experiments: 1. Development of dynamic vehicle model using MATLAB. 2. Simulation of EV powered by brushless DC motor using MATLAB. Software Required: MATLAB													CO-2 BTL-4		
MODULE 3: BATTERY TECHNOLOGY FOR EVs														(6L+ 6P)	
Battery Selection Methodology for EVs and HEVs – Battery sizing and considerations for EV application - Basics of Thermal Management System Design – Battery Management System - Energy Storage systems for Electric and Hybrid Vehicle Applications Suggested Reading: Battery Management System Design using MATLAB Lab Experiments: 1. Estimation of Battery State-of-Charge using MATLAB/Simulink 2. Estimation of Battery State-of-Health using MATLAB/Simulink Software Required: MATLAB													CO-3 BTL-3		
MODULE 4: CHARGING SYSTEM TECHNOLOGY FOR EV APPLICATIONS														(6L+ 6P)	

Charging system design considerations – AC Charging – DC Charging - Fast charging and its limitations - Smart charging and applications - Vehicle to grid (V2G) technology – Case Study Suggested Reading: Electromagnetic Compatibility Testing of EV & HEV Components Lab Experiments: 1. Modelling and Simulation of an Electric Vehicle with MATLAB/Simulink Software Required: MATLAB		CO-4 BTL-4
MODULE 5: FUTURE TRENDS IN ELECTRIC VEHICLES (6L+ 6P)		
Wireless and on-road charging of EV - Battery swap technology - Autonomous driving - Charging EVs from renewables - Case study Suggested Reading: EV Charging with Renewable Energy using MATLAB Lab Experiments: 1. Modeling and Simulation of plug-in hybrid electric vehicle using MATLAB Software Required: MATLAB		CO-5 BTL-4
TEXT BOOKS		
1.	Liu, Wei, “Hybrid electric vehicle system modeling and control”, John Wiley & Sons, 2017.	
2.	Donateo, T., “Hybrid electric vehicles”, BoD–Books on Demand, 2017.	
REFERENCE BOOKS		
1.	Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K., “Modern electric, hybrid electric, and fuel cell vehicles”, CRC press, 2018.	
2.	Erjavec, J., “Hybrid, electric, and fuel-cell vehicles”, Cengage Learning, 2016.	
E RESOURCES FOR REFERENCE		
1.	https://onlinelibrary.wiley.com/doi/book/10.1002/9781119278924	
2.	https://www.sciencedirect.com/book/9780444535658/electric-and-hybrid-vehicles	
MOOC		
1.	https://onlinecourses.nptel.ac.in/noc22_ee53/preview	
2.	https://www.udemy.com/course/electric-vehicles/	

COURSE TITLE	CODING FOR EV				CREDITS	3
COURSE CODE	EAT51525	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2	
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3	
ASSESSMENT SCHEME						
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department	Attendance	End Semester Examination	

				Examination Committee “DEC”			Theo ry	Practical							
15%	15%	10%	5%	5%	25%	25%									
Course Description	Programming in R and use of associated Open Source tools. Addressing practical issues in documenting workflow, data management, and scientific computing.														
Course Objectives	1. To learn the concepts of R Language 2. To learn the Data Analysis 3. To import a variety of data formats into R using RStudio 4. Prepare or tidy data’s for in preparation for analysis 5. Analyse a data set in R and present findings using the appropriate packages.														
Course Outcomes	Upon completion of this course, the students will be able to 1. Describe the fundamental syntax of R through readings, practice exercises, demonstrations, and writing R code. 2. Apply critical programming language concepts such as data types, iteration, control structures, functions, and Boolean operators by writing R programs and through examples 3. Demonstrate an understanding of Data Import and parsing 4. Recognize the principles of the Relations of Data. 5. Generate the Pattern and Regular Expression.														
Prerequisites: Programming Knowledge															
CO, PO AND PSO MAPPING															
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2	
CO-1	3	3	2	2	2	1	1	-	2	2	2	-	3	3	
CO-2	3	3	2	2	2	1	1	-	2	2	2	-	3	3	
CO-3	3	3	2	2	2	1	1	-	2	2	2	-	3	3	
CO-4	3	3	2	2	2	1	1	-	2	2	2	-	3	3	
CO-5	3	3	2	2	2	1	1	-	2	2	2	-	3	3	
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated															
MODULE 1: INTRODUCTION													(6L+6P)		
History and Overview of R - Getting Started with R - Getting started with the R interface - R Nuts and Bolts- Getting Data In and Out of R - Using the reader Package- Using Textual and Binary Formats for Storing Data- Interfaces to the Outside World - Subsetting R Objects - Vectorised Operations-Dates and Times-Matrices Lab Experiment: 1. Installation of RStudio and configuration 2. Programming Exercise based on Vectors 3. Programming exercise based on Matrices Software: R Studio													CO-1 BTL-3		
MODULE 2: CONTROL STRUCTURES													(6L+6P)		
Matrices- Arrays- Factors- Data Frames -Managing Data Frames with the dplyr package-Control Structures-Functions-Scoping Rules of R Coding Standards for R-Loop													CO-2 BTL-3		

Functions-List -Debugging-Profiling R Code-Simulation- Data Analysis Case Study: Changes in Fine Particle Air Pollution in the in Chennai. Lab Experiment: 1. Programming Exercise based on Simple functions 2. Practise the Programming based on Data Frame 3. Practise R program using List and Array Software: Rstudio	
MODULE 3: PACKAGES & FILES	
Packages- Data Reshaping- CCV Files- Excel File- Binary Files XML Files- JSON File- Web Data- Databases- PIE Charts- BAR Charts- Boxplots- Histograms- Line Graphs- Scatterplots- Mean, Median & Mode- Linear Regression- Multiple Regression- Logistic Regression- Normal Distribution- Binomial Distribution- Poisson Regression- Analysis of Covariance Time Series Analysis- Nonlinear Least Square- Decision Tree- Random Forest- Survival Analysis- Chi Square Test. Lab Experiment 1. Practise the Program using Array 2. Write a Program to handle the CCV, Excel, Binay, XML, JSON Files 3. Apply the R tool for Time Series Analysis of any real time data set, 4. Practise the PIE Charts, BAR Charts, Boxplots in R studio Software: Rstudio	CO-3 BTL-3
MODULE 4: DATA VISUALIZATION	
Data Visualization with ggplot2: Introduction -First Steps - Aesthetic Mappings - Common Problems – Facets - Geometric Objects - Statistical Transformations - Position Adjustments - Coordinate Systems - The Layered Grammar of Graphics – Workflow Basic - Data Transformation with dplyr – Workflow Scripts. PIE Charts- BAR Charts- Boxplots- Histograms- Line Graphs- Scatterplots. Lab Experiment: 1. working on mpg data frame, gg plot 2. Apply aesthetic is a visual property of the objects in your plot. 3. Implement with sample Data Transformation with dplyr Software: Rstudio	CO-4 BTL-3
MODULE 5: EXPLORATORY DATA ANALYSIS	

Introduction - Questions - Variation - Missing Values - Covariation - Patterns and Models - ggplot2Calls - Learning More - Workflow: Projects - What Is Real? - Where Does Your Analysis Live? – Paths and Directories - RStudio Projects.		CO-5 BTL-3
Lab Experiment: 1. Implement the Visualizing Distributions with sample data with relevant variables 2. Explore the distribution of each of the x, y, and z variables in diamonds. Think about a diamond and how you might decide which dimension is the length, width, and depth with sample data. 3. Build the Sentiment Analysis Model in R and Perform the Sentiment Analysis with the Inner Join.		
Software: Rstudio		
TEXT BOOKS		
1.	Roger D. Peng, "R Programming for Data Science" Leanpub,2015.	
2.	Hadley Wickham and Garrett Golemund - "R for Data Science" O'Reilly Media, Inc.,2017.	
REFERENCE BOOKS		
1.	Ross Ihaka and Robert Gentleman, "R Programming" Tutorials Point (I) Pvt. Ltd, 2016.	
2.	Garrett Golemund , "Hands-On Programming with R" , O'Reilly Media, Inc 2014.	
E BOOKS		
1.	https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf/	
MOOC		
1.	https://campus.datacamp.com/courses/introduction-to-the-tidyverse/data-wrangling-1?ex=1/	

Specialization 2: Intelligent Mobility

COURSE TITLE	AUTOMOTIVE SAFETY SYSTEMS			CREDITS	3
COURSE CODE	EAT51526	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE
15%	15%	10%	5%	5%	Theory 25% Practical 25%
Course Description	This course imparts understanding of role of safety systems in automobiles through technology.				
Course Objectives	1. To design and validate the vehicle structure with respect to crash worthiness 2. To know the various types of safety aspects such as active and passive safety, the active safety components and the working passive safety components such as air bags, seatbelts 3. To know about various object detection system and working of various comfort, convenience system and environment information system. 4. To analyze and simulate vehicle in barrier impacts.				

	5. To analyze pedestrian safety by use of light measurement and testing													
Course Outcomes	1. Design and validate the vehicle structure with respect to crash worthiness													
	2. Demonstrate the various types of safety aspects													
	3. Discuss on various object detection system and working of various comfort, convenience system and environment information system.													
	4. Analyze and simulate vehicle in barrier impacts.													
	5. Analyze pedestrian safety by use of light measurement and testing													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	2	3	2	1	1	1	1	3	3	3	3	3
CO-2	3	3	1	2	1	2	2	1	2	2	2	2	3	3
CO-3	2	2	3	3	3	1	3	2	1	1	1	2	3	3
CO-4	1	2	1	3	2	3	1	2	2	2	1	1	3	3
CO-5	2	1	2	3	3	3	2	2	2	2	2	1	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1- INTRODUCTION TO VEHICLE SAFETY, STRUCTURAL CRASHWORTHINESS AND CRASH TESTING													(6L+6P)	
Automotive Safety-Active and Passive Safety, Driver Assistance Systems in Automobiles, Definitions and Terminology, Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumple zone, safety sandwich construction. Optimization of Vehicle Structures for Crash Worthiness, Types of Impacts, and Impact With Rebound, Movable Barrier Tests, Roll Over Crash Tests, Behavior of Specific Body Structures in Crash Testing, Photographic Analysis of Impact Tests. LAB- Modeling and Simulation Studies													CO-1 BTL-3	
Module 2 – VEHICLE SAFETY SYSTEMS													(6L+6P)	
The concept of vehicle safety; Need of safety, Active safety: driving safety, conditional safety, perceptibility safety, operating safety-crash safety passive safety: exterior safety, interior, safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Safety equipment: Seat belt, regulations, automatic seat belt tightened system, Anti-locking braking system (ABS), Speed limiting device (SLD), automatic vehicle stability control, Collapsible steering system, tilt able steering system, air bags, electronic system for activating air bags, bumpers design for safety. Warning devices, indicators, hinges, latches, wipers, horns, etc. LAB- Fire detection and suppression system (FDSS), automatic traction control													CO-2 BTL-3	
Module 3 – VEHICLE INTEGRATION AND NAVIGATION SYSTEM													(6L+6P)	
Looking out sensors and Looking in sensors, Intelligent vision system, Vehicle Integration system. Global Positioning System. Vehicle Navigation System. Road Network.V2V, SAE levels of automation LAB- Sensors													CO-3 BTL-3	
Module 4 – ERGONOMICS AND HUMAN RESPONSE TO IMPACT													(6L+6P)	
Importance of Ergonomics in Automotive Safety, Locations of Controls, Anthropometry, Human Impact Tolerance Determination of Injury Thresholds, Severity Index, Study of Comparative Tolerance, Application of Trauma for Analysis of Crash Injuries. Injury Criteria’s and Relation with Crash and Modeling and Simulation Studies in Dummy LAB- Analysis and Simulation of Vehicle in Barrier Impacts													CO-4 BTL-3	
Module 5 – LIGHT MEASUREMENTS, TESTING EQUIPMENT, CALIBRATION AND PHOTOMETRIC PRACTICE													(6L+6P)	

Basics of Standards and Detectors, Spectral Measurements and Colorimetry, Illuminant Meters and Luminance Meters, Colorimeters. Fundamentals of Equipment Used for Light Measurement in Automotive Field - Gonio- Photometer, Reflecto-Meter, Colorimeter, Integrating Sphere, Types, Application, Coordinates System, Types of Sensors and Working Principle, Construction, Characteristics Etc. Used in Different Equipment. National and International Regulations, Test Requirements and Testing Procedure		CO-5 BTL-4
LAB-Case Studies		
TEXT BOOKS		
1.	Johnson W and Mamalis A.G., "Crashworthiness of Vehicles", Mechanical Engineering Publications, 2002.	
2.	Ljubo Vlacic, Michel Parent, Fumio Harashima – "Intelligent Vehicle Technologies Theory and Applications" -Butterworth-Heinemann, 2001	
REFERENCE BOOKS		
1.	J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori - "Sensors for Automotive Applications " -WILEYVCH Verlag GmbH & Co. 2003	
2.	ARAI Safety standards	
E BOOKS		
1.	Matthew Huang, "Vehicle Crash Mechanics", CRC Press,2002	
2.	J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori - "Sensors for Automotive Applications " -WILEYVCH Verlag GmbH & Co. 2003	
3.	Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999	
MOOC		
1.	https://onlinecourses.nptel.ac.in/noc20_de06/preview	
2.	https://www.edx.org/course/road-traffic-safety-in-automotive-engineering	

COURSE TITLE	AUTOMOTIVE ELECTRONIC ENGINE MANAGEMENT SYSTEM			CREDITS	3
COURSE CODE	EAT51527	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE
15%	15%	10%	5%	5%	Theory 25%
					Practical 25%
Course Description	This course will enable the students to gain knowledge about fundamentals of automotive electronics and electronic engine management systems.				
Course Objectives	1. To study the concepts on automotive electronics. 2. To identify the engine parameter by using different types of sensors. 3. To describe engine management systems of S.I engine. 4. To describe engine management systems of C.I engine. 5. To Illustrate electronic ignition system and engine mapping				
Course Outcomes	Upon completion of this course, the students will be 1. State the concepts on automotive electronics.				

	2. Identify the engine parameter by using different types of sensors. 3. Develop engine management systems of S.I engine. 4. Design engine management systems of C.I engine. 5. Illustrate electronic ignition system and engine mapping													
Prerequisites: EEB4101- Introduction to Digital Systems														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	0	0	0	1	0	0	0	0	0	0	1	1	1
CO-2	1	2	0	0	0	0	0	0	0	0	0	2	2	0
CO-3	0	0	0	0	0	1	0	0	0	0	0	1	0	2
CO-4	0	0	0	0	1	0	0	0	0	0	0	1	1	2
CO-5	0	0	3	0	1	0	0	0	0	0	0	2	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: - FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS													(6L+6P)	
Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. A/D and D/A controllers. Suggested Reading: Advancements in closed loop control, Programme in look up table													CO-1 BTL-1	
MODULE 2: - SENSORS													(6L+6P)	
Types – Mass Air flow, Manifold Absolute Pressure, Temperature, Speed, EGO, Knock, and Crankshaft Position-Hall Effect-Principle of operation, construction, material and characteristics. Suggested Reading: Types of MAP sensors, Camshaft Position sensor, Speed sensor													CO-2 BTL-2	
MODULE 3: - S.I ENGINE MANAGEMENT													(6L+6P)	
Mono point, Multi point and Direct injection systems - Principles and Features, Bosch injection systems- L-Jetronic and LH –Jetronic- Layout and working, Open loop control and Lambda loop control in injection. Suggested Reading: K-Jetronic, KE-Jetronic, Motronic Systems													CO-3 BTL-2	
MODULE 4: - C.I ENGINE MANAGEMENT													(6L+6P)	
Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Inline injection pump, Rotary pump and injector - Construction and principle of operation, electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Suggested Reading: Nozzle spray characteristics, Types of Nozzles, Types of combustion Chambers													CO-4 BTL-2	
MODULE 5: IGNITION SYSTEMS AND ENGINE MAPPING													(6L+6P)	
Ignition fundamentals, Types of solid state ignition systems, High energy ignition distributors, Electronic spark timing and control. Combined ignition and fuel management systems. Digital control techniques - Dwell angle, Ignition timing and Injection duration calculation. Suggested Reading: Electronic Ignition system, Optimization techniques in ignition and injection timing													CO-5 BTL-3	
TEXT BOOKS														
1.	William B. Ribbens., “Understanding Automotive Electronics an Engineering Perspective” Eighth Edition. 2017													
2.	Tom Denton., “Automobile Electrical and Electronic Systems” 3 rd edition 2014.													
REFERENCE BOOKS														

1.	Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680-9567-8.
2.	Robert Bosch, "Gasoline Engine Management- system and component. 2014.
3.	Robert Bosch "Diesel Engine Management" -4 th edition 2006.

Specialization 3: Engine and Vehicle Technology

COURSE TITLE	RENEWABLE SOURCE OF ENERGY				CREDITS	3								
COURSE CODE	EAT51528	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2									
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-3									
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	ESE									
15%	15%	10%	5%	5%	Theory 25% Practical 25%									
Course Description	This course enhances the reader the availability, feasibility, methods of utilization of the various renewable sources of energy with respect to the application. This also enables the reader the advantages, limitations and the methods to overcome the limitations by the additional equipment to obtain the required outcome													
Course Objectives	1. Create awareness about sources of energy and able to estimate how long theavailable conventional fuel reserves will last 2. Learn the fundamental concepts about solar energy systems and devices 3. Design wind turbine blades and know about applications of wind energy for water pumping and electricity generation 4. Understand the working of OTEC system and different possible ways of extracting energy from ocean, know about Biomass energy. 5. Design the utilization method from the energy of Hydel and geothermal system													
Course Outcomes	Upon completion of the course the students are able to: 1. Discuss on renewable and non-renewable sources of energy 2. Gain knowledge about working principle of various solar energy systems 3. Develop the application of wind energy and wind energy conversion system 4. Interpret capability to do basic design of bio gas plant 5. Discuss the applications of different renewable energy sources like ocean thermal, hydro, geothermal energy etc.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO-1	1	1	1	1	2	2	2	2	2	2	1	1	1	1
CO-2	1	1	1	1	2	2	2	2	2	2	1	1	1	1
CO-3	1	1	1	1	2	2	2	2	2	2	1	1	1	1
CO-4	1	1	1	1	2	2	2	2	2	2	1	1	1	1
CO-5	1	1	1	1	2	2	2	2	2	2	1	1	1	1
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – INTRODUCTION TO ENERGY STUDIES													(6L+6P)	

Introduction, Energy science and Technology, Forms of Energy, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Roles and responsibility of Ministry of New and Renewable Energy Sources, Needs of renewable energy, Classification of Energy Resources, Conventional Energy Resources , Non- Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario.	CO-1 BTL-3
Module 2 – SOLAR ENERGY	(6L+6P)
Introduction, Solar Radiation, Sun path diagram, Basic Sun-Earth Angles, Solar Radiation Geometry and its relation, Measurement of Solar Radiation on horizontal and tilted surfaces, Principle of Conversion of Solar Radiation into Heat, Collectors, Collector efficiency, Selective surfaces, Solar Water Heating system, Solar Cookers , Solar driers, Solar Still, Solar Furnaces, Solar Greenhouse. Solar Photovoltaic, Solar Cell fundamentals, Characteristics, Classification, Construction of module, panel and array. Solar PV Systems (stand-alone and grid connected), Solar PV Applications. Government schemes and policies.	CO-2 BTL-3
Module 3 – WIND ENERGY	(6L+6P)
Introduction, History of Wind Energy, Wind Energy Scenario of World and India. Basic principles of Wind Energy Conversion Systems (WECS), Types and Classification of WECS, Parts of WECS, Power, torque and speed characteristics, Electrical Power Output and Capacity Factor of WECS, Stand alone, grid connected and hybrid applications of WECS, Economics of wind energy utilization, Site selection criteria, Wind farm, Wind rose diagram.	CO-3 BTL-3
Module 4 – BIOMASS ENERGY	(6L+6P)
Introduction, Biomass energy, Photosynthesis process, Biomass fuels, Biomass energy conversion technologies and applications, Urban waste to Energy Conversion, Biomass Gasification, Types and application of gasifier, Biomass to Ethanol Production, Biogas production from waste biomass, Types of biogas plants, Factors affecting biogas generation, Energy plantation, Environmental impacts and benefits, Future role of biomass , Biomass programs in India.	CO-4 BTL-3
Module 5 – HYDRO POWER AND OTHER RENEWABLE ENERGY SOURCES	(6L+6P)
Hydropower: Introduction, Capacity and Potential, Small hydro, Environmental and social impacts. Tidal Energy: Introduction, Capacity and Potential, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy: Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation. Geothermal Energy: Introduction, Capacity and Potential, Resources of geothermal energy.	CO-5 BTL-4
TEXT BOOKS	
1.	Twidell, J.W. & Weir, A. Renewable Energy Sources, EFN Spon Ltd., UK, 2006
2.	B. H. Khan, Non-Conventional Energy Resources, , The McGraw Hill
REFERENCE BOOKS	
1.	G.D. Rai, Non-Conventional Energy Sources, Khanna Publications, New Delhi, 2011
2.	Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", OxfordUniversity Press, U.K., 1996
E BOOKS	
1.	https://www.uobabylon.edu.iq/eprints/publication_4_10679_78.pdf
2.	https://drive.google.com/drive/folders/1hfCGgh8eMJfNHbfHu10Ja2GSTzmuRro0?usp=sharing
MOOC	
1.	https://archive.nptel.ac.in/courses/121/106/121106014/
2.	https://nptel.ac.in/courses/108105058

COURSE TITLE	AUTOMOTIVE HEATING VENTILATION AIR-CONDITIONING (HVAC)					CREDITS	3							
COURSE CODE	EAT51529		COURSE CATEGORY		DE		L-T-P-S	2-0-2-2						
VERSION	1.0		APPROVAL DETAILS		36 TH ACM		LEARNING LEVEL	BTL-3						
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)		Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		ESE					
15%	15%		10%		5%		5%		Theory 25% Practical 25%					
Course Description	To enable the students gain knowledge on Automotive air conditioning, Electronic climate control and Air conditioning service.													
Course Objectives	The course should enable the students to: 1. To know about the automotive air conditioning fundamentals. 2. To understand the concepts and components of automotive cooling and heating systems 3. To learn about the refrigerants and handling of refrigerants. 4. To Know the working of automotive sensors used for climate and temperature control. 5. To Know about the servicing of automotive air conditioning system.													
Course Outcomes	The students should be able to: 1. Familiarize on fundamentals of automotive air conditioning systems. 2. Gain knowledge on the concepts and components of automotive cooling and heating systems. 3. Acquire the knowledge on refrigerants and its handling. 4. Attain the knowledge on working of automotive sensors for climate and temperature control. 5. Familiarize on servicing of automotive air conditioning system.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	2	3	1	2	0	2			1	1	1	1
CO-2	3	1	2	1	1	1		1			1	1	1	1
CO-3	3	1	2	1	1	1		1			1	1	1	1
CO-4	3	1	2	1	1	1		1			1	1	1	1
CO-5	3	1	2	1	1	1		1			1	1	1	1
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Basics of Air Conditioning										(6L+6P)				
Introduction to HVAC- Environmental Concerns- Ozone layer depletion. Location of air conditioning components in a car – Schematic layout of a vehicle refrigeration system. Psychometric – Basic terminology and Psychometric mixtures- Psychometric Chart- Related simple basic problems Practical Component: Study and sketching of the schematic layout of air-conditioning system in an automobile										CO-1 BTL-3				
Module 2 – Air Conditioning Systems										(6L+6P)				
Vehicle Refrigeration System and related problems- Fixed thermostatic and Orifice tube system- Variable displacement thermostatic and Orifice tube system- Vehicle air conditioning										CO-2 BTL-3				

operation Types of compressor- Compressor Clutches- Compressor Clutch electrical circuit- Compressor lubrication- Condensers- Evaporators- Expansion devices- Evaporator temperature and pressure controls- receiver-drier- Accumulators- refrigerant hoses, Connections and other assemblies- Heating system Practical Component: Identification of Air conditioning system components Removal and Assembly of air filters		
Module 3 – Climate Control		(6L+6P)
Different types of sensors and actuators used in automatic temperature control- Automotive air conditioning manual control system, auto temperature control system, Automotive climate control system. Practical Components Study and testing of sensors uses in Automotive Air conditioning		CO-3 BTL-3
Module 4 – Maintenance of Automobile Air Conditioning		(6L+6P)
Temperature measurements – Refrigerant recovery, recycle and charging-system flushing, Retrofitting – Replacement and adjustment of compressor components Handling Practical Component; Refrigerant Charging in an Automobile.		CO-4 BTL-3
Module 5 – Refrigerants		(6L+6P)
Refrigerants – Discharging, Charging & Leak detection Containers handling refrigerants, tapping into the refrigerant container refrigeration system diagnosis, diagnostic procedure, ambient conditions affecting system pressures Practical Component: Detection of Refrigerant leakage in an automobile		CO-5 BTL-3
TEXT BOOKS		
1.	Steven Daly- “Automotive Air –Conditioning Climate Control Systems” - Butterworth – Heinemann – Elsevier Publications -2011.	
2.	William H. Crouse and Donald I. Anglin - “Automotive Air conditioning” - McGraw Hill Inc. - 1990.	
REFERENCE BOOKS		
1.	Boyce H. Diggins - “Automotive Air Conditioning” - Delmar – 2002.Mitchell information Services, Inc - “Mitchell Automatic Heating and Air Conditioning Systems” - Prentice Hall Ind. – 1989	
2.	Paul Weiser - “Automotive Air Conditioning” - Reston Publishing Co., Inc., - 1990	
E BOOKS		
1.	https://www.elsevier.com/books/automotive-air-conditioning-and-climate-control-systems/daly/978-0-7506-6955-9	
2.	https://link.springer.com/book/10.1007/978-3-319-33590-2	
MOOC		
1.	https://nptel.ac.in/courses/112107208	
2.	https://www.edx.org/course/distribution-and-control-of-heat-cold-and-air-flows-in-buildings	

Specialization 4: Design and Manufacturing

COURSE TITLE	DESIGN OF EXPERIMENTS			CREDITS	3
COURSE CODE	EAT51530	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					

First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	ESE									
15%	15%	10%	5%	5%	Theory 25% Practical 25%									
Course Description	This course gives knowledge on how to design the experimental works and statistical analysis to obtain the optimized results in economical way with less number of experiments.													
Course Objectives	This course aims to give knowledge on the following topics 1. To understand principles and guidelines of Design of Experiments 2. To Randomize block design 3. To do factorial design 4. To follow Taguchi method and Regression Analysis 5. To use Response Surface Methodology in DOE													
Course Outcomes	Upon completion of this course, the students will be able to 1. Familiarize on the principles and guidelines of Design of Experiments 2. Analyze the randomized block design 3. Analyze the factorial design 4. Solve problems by Taguchi method and Regression Analysis 5. Analyze the importance of Response Surface Methodology in DOE													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	2	1	1	-	1	-	-	-	-	-	-	1	2	1
CO-2	1	2	1	-	-	-	-	-	-	2	-	2	1	1
CO-3	2	1	2	-	-	1	-	-	-	-	-	1	2	2
CO-4	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO-5	1	1	3	-	-	-	-	-	-	-	-	2	1	1
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
MODULE 1 – Experiments with a Single Factor													(6L+6P)	
Basic principles and guidelines of Design of Experiments – Single Factor Experiments – ANOVA – Model Adequacy Checking – Determining Sample Size – Comparing Pairs of Treatment Means – Introduction to DOAE software.													CO-1 BTL-3	
MODULE 2 – Randomized Block Designs													(6L+6P)	
Randomized complete block design – Latin Square Design – Graeco-Latin Square Design – Balanced Incomplete Block Design													CO-2 BTL-3	
MODULE 3 – Factorial Designs													(6L+6P)	
Two Levels – 2K Factorial Designs – Confounding and Blocking in Factorial Designs													CO-3 BTL-3	
MODULE 4 – Fractional Factorial Designs													(6L+6P)	
The One-Half and One-Quarter Fraction of the 2K Design – General 2K-P Fractional Factorial Design - Resolution													CO-4 BTL-3	
MODULE 5 – Robust Design													(6L+6P)	
Taguchi’s Approach – Orthogonal Design – S/N ratio – Regression Analysis – Response Surface Methodology.													CO-5 BTL-3	
TEXT BOOKS														
1	Douglas C. Montgomery, (2017), Design and Analysis of Experiments, John Wiley & Sons, Inc., 10 th edition.													
2	R. Panneerselvam, (2012), Design and Analysis of Experiments, PHI Learning Pvt Ltd.													
REFERENCE BOOKS														
1	Philip J. Rose, (2000), Taguchi Techniques for quality Engineering, Printice Hall													
2	K. Krishaiah, P. Shahabuddeen (2012) Applied Design of Experiments and Taguchi Methods. PHI Publications.													

E BOOKS	
1	https://faculty.ksu.edu.sa/sites/default/files/douglas_c._montgomery-design_and_analysis_of_experiments-wiley_2012_edition_8.pdf
2	https://books.google.co.in/books?hl=en&lr=&id=Q_JtuJ7uNRAC&oi=fnd&pg=PR1&dq=design+and+analysis+of+experiments+paneerselvam+pdf&ots=WGrWA1O362&sig=ji4aBmj-u7Nk3kshWWdCrqrjVug#v=onepage&q&f=false

COURSE TITLE	INDUSTRIAL ENGINEERING AND MANAGEMENT			CREDITS	3
COURSE CODE	EAT51531	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessment	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE
15%	15%	10%	5%	5%	Theory 25%
					Practical 25%
Course Description	This course describes the necessary qualitative and quantitative skills for an Industrial Engineer to showcase as a better administration and productivity in the manufacturing sector.				
Course Objectives	1. The aim of the course is to give the student theoretical insights and practical tools within the area of management and organisation of industrial corporations. 2. To explain the business house to increase its production in the scientific methods. 3. To interpret the inventory and stores management for the effective introduction of control methods. 4. To analyse the explain material requirement planning and store keeping procedure and list the PPC functions. 5. To classify the training, industrial training methods in the organization.				
Course Outcomes	Upon completion of this course, the students will be able to 1. Exhibit theoretical and practical tools within the area of management and organization of industrial corporations. 2. Implement new methodology in the business house to increase its production following the scientific methods. 3. Develop the inventory and stores management by introducing modern control methods. 4. Design and evaluate the material requirement planning and store keeping procedure adapting the PPC functions. 5. Carry out innovative and research oriented personal training, industrial training and motivational activities.				

Prerequisites: Nil

CO, PO AND PSO MAPPING														
COs	POs												PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2
CO-1	3	2	1	1	3	2	2	2	0	2	2	2	3	2
CO-2	3	2	1	2	2	2	2	1	3	2	3	1	3	2
CO-3	3	3	2	2	3	3	3	2	3	2	1	1	3	2
CO-4	3	2	2	1	3	3	3	2	3	3	2	1	3	2
CO-5	3	2	2	1	3	3	3	1	3	3	1	3	3	2

1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated

Module: I -Introduction to Industrial Management		(6L+6P)
Industrial Management –Concept Meaning and Definitions - Scope of Industrial Management - Application of Industrial Management -Objectives of Industrial Management -Significance of Industrial Management - Difference between Industrial Management & Production Management - Recent trends in Industrial Management.		CO-1 BTL-2
Moule: II -Productivity Management		(6L+6P)
Productivity Management: • Concept of Productivity, its importance & nature. Factors affecting industrial productivity. Barriers of Productivity. Management of Productivity Misunderstanding about productivity. Productivity improvement techniques. Efficiency and effectiveness .		CO-2 BTL-2
Module III –Materials Management		(6L+6P)
Material management-definition, functions, Purchase - objectives, purchasing systems, purchase procedure, Storekeeping- functions, classification of stores as centralized and decentralized with their advantages, Functions of store, types of records maintained by store, Inventory control- Definition- Objectives. - Derivation for expression for Economic Order Quantity (EOQ) and numeric examples. ABC analysis and other modern methods of analysis. Material Requirement Planning (MRP)- concept, applications and brief details about software packages available in market.		CO-3 BTL-3
Module IV -Production Planning and Control (PPC).		(6L+6P)
Types and examples of production- PPC : Need and importance-Functions - Forms used and their importance. Scheduling- meaning and need for productivity and utilization. Scheduling using Gantt Chart . Meaning objectives- Importance- space- production planning – function, techniques of PPC- Routing-scheduling –Despatching- and follow-up Limitations PPC		CO-4 BTL-2
Module V – Human Resource Management		(6L+6P)
Employee Training and Development: Introduction- Need for training- Steps in designing training programme- Methods of training. Performance Appraisal: Meaning – Purpose- Methods- Ethics in appraisal. Industrial Relations - Importance- objectives- Participants in Industrial Relations-Worker’s Participations in Management. Employee Morale -Meaning-Importance- factors affection morale – Improving Morale.		CO-5 BTL-3
TEXT BOOKS		
1.	P. Khanna, “Industrial Engineering and Management”, Dhanpatrai publications Ltd, New Delhi.	
2.	Srivastava R.M. Management Policy and Strategic Management, concepts, skills and practices HPH- 1999.	
REFERENCE BOOKS		
1.	K. Shridhara Bhat, “Materials and Logistics Management”, Himalaya Publishing House, Mumbai	
2.	Dinesh Seth and Subhash C. Rastogi, “Global Management Solutions”, Cengage Learning, Second Edition, USA.	
3.	N.V.S. Raju, Industrial Engineering & Management, Cengage Group,2013, ISBN: 9788131519486	
E BOOKS		
1.	https://www.phindia.com/Books/BookDetail/9788120351103/industrial-engineering-and-management-ravi	
2.	https://www.springer.com/series/11690	
3.	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470172339	
MOOC		
1.	https://onlinecourses.nptel.ac.in/noc22_me04/preview	
2.	https://www.shiksha.com/online-courses/nptel-project-management-course-course-nptel19	
3.	https://nptel.ac.in/courses/112107143	

Semester –VII

Department Elective- 5

Specialization 1: ELECTRIC VEHICLE TECHNOLOGY

COURSE TITLE		COMPUTER ARCHITECTURE AND DATA ANALYTICS					CREDITS		3						
COURSE CODE	EAT51532	COURSE CATEGORY		PC	L-T-P-S	2-0-2-2									
VERSION	1.0	APPROVAL DETAILS		36 th ACM	LEARNING LEVEL	BTL-3									
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination										
					Theory	Practical									
15%	15%	10%	5%	5%	25%	25%									
Course Description	This course introduces the principles of computer organization and the basic architecture concepts.														
Course Objectives	1. Recall the basic structure and operation of a computer system. 2. Familiarize with arithmetic and logic unit and implementation of different arithmetic operations. 3. Explain the concept of pipelining and parallelism. 4. Know the difference between Cache and Virtual memory and related performance issues. 5. Demonstrate different ways of communicating with I/O devices and standard I/O interfaces.														
Course Outcomes	Upon completion of this course, the students will be able to 1. Recall the basic structure and operation of a computer system. 2. Familiarize with arithmetic and logic unit and implementation of different arithmetic operations. 3. Explain the concept of pipelining and parallelism. 4. Know the difference between Cache and Virtual memory and related performance issues. 5. Demonstrate different ways of communicating with I/O devices and standard I/O interfaces.														
Prerequisites: NIL															
CO, PO AND PSO MAPPING															
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	
CO-1	3	3	2	2	2	2	-	2	-	-	2	2	1	1	
CO-2	3	3	2	2	2	2	-	2	-	-	2	2	1	1	

CO-3	3	3	2	2	2	2	-	2	-	-	2	2	1	1	
CO-4	3	3	2	2	2	2	-	2	-	-	2	2	1	1	
CO-5	3	3	2	2	2	2	-	2	-	-	2	2	1	1	
1 – Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated															
MODULE 1: COMPUTER TECHNOLOGIES														(6L+6P)	
Eight ideas – Components of a computer system – Technology – Performance – Power wall –Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions – Addressing and addressing modes. Practical Component: 1. Practise onGNU Simulator 8085 2. Study the complete instruction set of 8085 and write the instructions in the instruction set of 8085 along with examples. Software/ Equipment required-GNUsim8085														CO-1 BTL-3	
MODULE 2: ARITHMETIC FOR COMPUTERS														(6L+6P)	
ALU - Integer Addition, Integer Subtraction, Dealing/Detecting with Overflow - Designing ALU for MIPS, Multiplication- Multiply Algorithm-Optimized Multiplier- Faster Multiplier, Division-Divide Algorithm-Optimized Divider – Floating Point Operations-Standard- IEEE Floating-Point Format. Practical Component: 1. Write an assembly language code in GNUsim8085 to implement data transfer instruction. 2. Write an assembly language code in GNUsim8085 to store numbers in reverse order in memory location. Software/ Equipment required-GNUsim8085														CO-2 BTL-3	
MODULE 3: MIPS & PIPELINING														(6L+6P)	
Basic MIPS implementation – Building data path – Control Implementation scheme – Pipelining – Pipelined data path and control – Handling Data hazards & Control hazards – Exceptions. Practical Component: 1. Write an assembly language code in GNUsim8085 to implement arithmetic instruction. 2. Write an assembly language code in GNUsim8085 to add two numbers using lxi instruction Software/ Equipment required-GNUsim8085														CO-3 BTL-3	
MODULE 4 - INSTRUCTION-LEVEL PARALLELISM														(6L+6P)	
Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multithreading – Multicore processors. Practical Component: 1. Write an assembly language code in GNUsim8085 to add two 8 bit numbers stored in memory and also storing the carry. 2. Write an assembly language code in GNUsim8085 to find the factorial of a number. Software/ Equipment required-GNUsim8085														CO-4 BTL-3	
MODULE 5 – MEMORY AND I/O														(6L+6P)	

Memory hierarchy - Cache Memory - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/O processors.		CO-5 BTL-3
Practical Component: 1. Write an assembly language code in GNUsim8085 to implement logical instructions. 2. Write an assembly language code in GNUsim8085 to implement stack and branch instructions. Software/ Equipment required -GNUsim8085		
TEXT BOOKS		
1.	David A. Patterson and John L. Hennessy, "Computer organization and design", Morgan Kaufmann / Elsevier, Fifth edition, 2013.	
2	William Stallings, "Computer Organization and Architecture", Tenth Edition, Pearson Education, 2016.	
REFERENCE BOOKS		
1.	V. Carl Hamacher, Zvonko G. Varanescic and Safat G. Zaky, "Computer Organisation", VI th edition, Mc Graw-Hill Inc, 2012.	
2	Vincent P. Heuring, Harry F. Jordan, "Computer System Architecture", Second Edition, Pearson Education, 2005.	
E- BOOKS		
1	https://theswissbay.ch/pdf/Books/Computer%20science/Computer%20Organization%20and%20Design-%20The%20HW%20Interface%205th%20edition%20-%20David%20A.%20Patterson%20%26%20John%20L.%20Hennessy.pdf	
2	https://inspirit.net.in/books/academic/Computer%20Organisation%20and%20Architecture%20e%20by%20William%20Stallings.pdf	
MOOC		
1.	https://www.mooc-list.com/course/computer-architecture-coursera	
2	https://www.mooc-list.com/course/fundamentals-computer-architecture-coursera	

COURSE TITLE	SMART GRID FOR EV			CREDITS	3	
COURSE CODE	EAT51533	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2	
Version	1.0	Approval Details	36th ACM	LEARNING LEVEL	BTL-3	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%

Course Description	This course mainly focusses on background and fundamental building blocks of smart grid with stringent emphasis on practical applications in the existing power system network. This course provides overview of smart grid and its potential in different types of power sectors such as power generation, transmission and distribution in Metro, Urban/Semi urban and remote locations of India.														
Course Objective	1. To familiarize the basic concepts, components and architecture of smart grid 2. To understand the various measurement technologies in smart grid														
Course Outcome	Upon completion of this course, the students will be able to 1. Apply economic fundamentals of power systems and electricity markets. 2. Solve problems of Optimal Power Flow 3. Explain the characteristics of smart grids 4. Explain concepts of various components of Smart Grid, and their impacts on the energy industry 5. Identify the threats and vulnerabilities of smart grid														
Prerequisites: Power System, Power Electronics															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	
CO-1	3	3	2	2	2	-	-	-	-	-	-	-	-	1	
CO-2	3	3	2	2	3	-	-	-	-	-	-	-	-	1	
CO-3	3	3	2	2	3	-	-	-	-	-	-	-	-	1	
CO-4	3	3	2	2	3	-	-	-	-	-	-	-	-	1	
CO-5	3	3	3	2	3	-	-	-	-	-	-	-	-	1	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: SUPPLY SIDE AND DEMAND SIDE OF ELECTRICITY													(6L+6P)		
Basics of electricity- Fossil fuel and hydro power plants- Renewable and alternative energy- Supply curve- Load characteristics- Load curve and load duration curve- Demand side management- Plug-in hybrid vehicles and smart appliances Suggested Reading: TNEB Demand supply handbook Lab Experiments: Integration of Renewable Energy Sources in Smart Grid.													CO-1 BTL-3		
MODULE 2: TRANSMISSION AND DISTRIBUTION NETWORKS													(6L+6P)		
Physical laws of electricity; AC vs. DC Power flow- Optimal power flow and unit commitment models- Distribution network basics Suggested Readings: Demand Side Management in India: Technology Assessment Lab Experiments: Solution of Optimal Power Flow Problem													CO-2 BTL-3		
MODULE 3: BASIC ELEMENTS AND DESIRABLE TRAITS OF SMART GRID													(6L+6P)		
The origin of power grid – dependency on power grid – desirable features of power grid-reliability – security –economic –efficiency –environmental friendly – safety. Suggested Readings: Smart Grid: Concepts and Deployment Lab Experiment: Reliability assessment of Power Grid													CO-3 BTL-3		

MODULE 4: KEY CHARACTERISTICS OF SMART GRID		(6L+6P)
Demand-side participation- Impacts of Smart Grid on reliability- Impacts of Smart Grid on air pollutant emissions reduction. Conformal mapping Suggested Readings: A Roadmap to Tamil Nadu’s Electricity Demand-Supply by 2050 Lab Experiment: Calculation of Air Pollution Reduction after Renewable Energy Source integration		CO-4 BTL-3
MODULE 5: ISSUES RELATED TO SMART GRID		(6L+6P)
Communication and sensing in a smart grid- smart grid threats-vulnerabilities-cyber security strategies. Suggested Readings: Smart grid Challenges Lab Experiment : Case Study on issues related to Smart Grid		CO-5 BTL-3
BOOKS		
1.	D. S. Kirschen and G Strbac , Fundamentals of Power System Economics, .Reprinted edition. John Wiley & Sons Ltd., 2017.	
2.	G. M. Masters , Renewable and Efficient Electric Power Systems, John Wiley & Sons, Inc., 2014.	
REFERENCE BOOKS		
1	S.Stoft , Power System Economics: Designing Markets for Electricity, Wiley-Interscience., 2013.	
2	A.Mazer , Electric Power Planning for Regulated and Deregulated Markets, John Wiley & Sons, Inc., 2014.	
E Resources for Reference		
1.	https://www.smartgrid.gov/files/sg_introduction.pdf	
2.	https://www.tandfonline.com/doi/full/10.1080/15325008.2013.868558	
MOOC		
1.	https://www.mooc-list.com/course/smart-grids-smart-cities-towards-zero-emissions-future learn	

Specialization 2: INTELLIGENT MOBILITY

COURSE TITLE	SELF DRIVING CARS			CREDITS	3
COURSE CODE	EAT51534	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36TH ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE
15%	15%	10%	5%	5%	Theory 25%
					Practical 25%
Course Description	This course provides knowledge on Hardware and Software architecture for self-driving cars and also knowledge on python programming.				
Course Objectives	1. To demonstrate on Autonomy, Hardware and Software architecture for self-driving cars 2. To design Safety Assurance, Vehicle Dynamic Modelling for self-driving cars 3. To develop Longitudinal and Lateral control for self-driving cars 4. To install and Utilize Python-Variables and Expressions				

	5. To develop Conditional Code- Functions- Loops and Iteration using Python.													
Course Outcomes	Upon completion of this course, the students will be able to													
	1. Demonstrate on Autonomy, Hardware and Software architecture for self-driving cars													
	2. Design Safety Assurance, Vehicle Dynamic Modelling for self-driving cars													
	3. Develop Longitudinal and Lateral control for self-driving cars													
	4. Install and Utilize Python-Variables and Expressions													
	5. Develop Conditional Code- Functions- Loops and Iteration using Python.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO -2	PO -3	PO -4	PO-5	PO-6	PO -7	PO -8	PO -9	P O -10	PO -11	PO -12	PSO -1	PSO -2
CO-1	2	1	2	1	-	-	2	1	-	1	2	1	2	2
CO-2	2	2	1	1	-	-	2	1	-	2	2	1	2	1
CO-3	1	1	2	1	-	-	1	2	-	1	2	1	1	2
CO-4	2	1	1	2	-	-	2	1	-	1	2	1	2	1
CO-5	1	1	1	1	-	-	2	1	-	1	2	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Autonomy, Hardware and Software architecture													(6L+6P)	
Introduction to Self-driving car – Taxonomy of Driving - Requirements for perceptions - Autonomy- Driving decisions - Self-Driving Hardware and Software Architectures for self-driving cars. Practice: Introduction to MATLAB.													CO-1 BTL-3	
MODULE 2: Safety, Vehicle Dynamic Modelling													(6L+6P)	
Safety Frameworks for Self-Driving - Methods for Safety Assurance and Testing -Safety Assurance for Autonomous Vehicles- Vehicle Dynamic Modeling -Kinematic Modeling in 2D -Dynamic Modeling in 2D - Dynamic Modeling in 3D. Practice: Kinematic Modeling and Dynamic Modeling using MATLAB.													CO-2 BTL-3	
MODULE 3: Longitudinal and Lateral control													(6L+6P)	
Introduction to Longitudinal Control- Longitudinal Vehicle Modeling – Introduction to Lateral Control - Lateral Vehicle Modeling – Vehicle – Vehicle Actuation. Practice: Longitudinal and Lateral control Modelling using MATLAB.													CO-3 BTL-3	
MODULE 4: Programming for Everybody (Python)													(6L+6P)	
Introduction to python - Installing Python and Writing A Program - Variables and Expressions – Writing python program for given expression - Demonstration of "Hello World". Practice: writing programme using PYTHON													CO-4 BTL-3	
MODULE 5: Programming for Everybody (Python)													(6L+6P)	
program uses the computer's memory to store - retrieve and calculate information - Conditional Code- Functions- Loops and Iteration. Practice: Python program for simple vehicle control and actuation.													CO-5 BTL-3	
Total hours													60	
TEXT BOOKS														
1.	Michael E. McGrath, Autonomous Vehicles: Opportunities, Strategies and Disruptions: Updated and Expanded Second Edition.													
2.	Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, A Chapman and Hall Book.													
REFERENCES														
1.	https://www.amazon.in/Introduction-Self-Driving-Technology-Artificial-Intelligence/dp/0367321262													
E-BOOKS														
1.	https://www.amazon.com/autonomous-vehicles-Books/s?k=autonomous+vehicles&rh=n%3A283155													
MOOC COURSES														
1.	https://www.coursera.org/learn/intro-self-driving-cars?													
2.	https://www.coursera.org/learn/python													

COURSE TITLE	POSE ESTIMATION AND STATE ESTIMATION OF SELF DRIVING CARS							CREDITS	3					
COURSE CODE	EAT51535		COURSE CATEGORY		DE			L-T-P-S		2-0-2-2				
Version	1.0		Approval Details		36 TH ACM			LEARNIN G LEVEL		BTL-3				
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)		Practical Assessment s		Observation / lab records as approved by the Department Examination Committee “DEC”			Attendance		ESE				
15%	15%		10%		5%			5%		Theory 25% Practical 25%				
Course Description	This course provides knowledge on Position and orientation Estimation, Pose Estimation from LIDAR Data, RADAR Data, GNSS/INS and Camera and computer vision													
Course Objectives	1. To understand the concept of Position and orientation Estimation 2. To utilize the Pose Estimation from LIDAR Data 3. To construct the Pose Estimation from RADAR Data 4. To develop Pose Estimation from GNSS/INS 5. To demonstrate the concept of Camera and computer vision													
Course Outcomes	Upon completion of this course, the students will be able to 1. Develop the concept of Position and orientation Estimation 2. Utilize the Pose Estimation from LIDAR Data 3. Construct the Pose Estimation from RADAR Data 4. Develop Pose Estimation from GNSS/INS 5. Demonstrate the concept of Camera and computer vision													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PS O-1	PS O-2
CO-1	2	2	1	3	-	1	-	1	-	1	1	1	1	2
CO-2	2	3	2	2	1	-	1	1	-	2	1	2	2	1
CO-3	1	2	1	2	-	-	-	1	-	1	1	1	1	2
CO-4	2	2	1	2	-	2	1	2	2	2	1	2	2	1
CO-5	2	1	1	2	1	-	-	1	-	1	1	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Position and orientation Estimation (6L+6P)														

Introduction to Position and orientation Estimation – Methodology – Compute Jacobian method – compute M Matrix method – Gauss Newton method – angle from quaternion – Gradient descent – kalman Filter - error-state extended Kalman filter.		CO-1 BTL-2
MODULE 2: LIDAR Sensor Models and Point Clouds (6L+6P)		
LIDAR Sensor -Pose (position and orientation) Estimation from LIDAR Data - Point Clouds – 3D & 2D Point Clouds - inverse and forward sensor models for a basic scanning LIDAR - iterative closest point (ICP) algorithm - problem of motion distortion can affect LIDAR scans acquired from a moving vehicle. <i>Practice- Design perception system using LIDAR Sensor in MATLAB Automated Driving Tool Box</i>		CO-2 BTL-3
MODULE 3: Pose Estimation from RADAR Data (6L+6P)		
RADAR Sensor - Sensor Models - Pose Estimation from RADAR Data – localization – path planning – decision making <i>Practice- Design perception system using RADAR Sensor in MATLAB Automated Driving Tool Box</i>		CO-3 BTL-3
MODULE 4: IMU for Pose Estimation (6L+6P)		
IMU- Sensor Models - Pose Estimation from IMU - coordinate acceleration - fundamental equation of inertial navigation - gyroscope and accelerometer measurement models in the context of navigation <i>Practice- Design perception system using IMU Sensor in MATLAB Automated Driving Tool Box</i>		CO-4 BTL-3
MODULE 5: Camera and computer vision - Pose Estimation methods (6L+6P)		
<i>Computer Vision, Estimation, Random Sample Consensus (Ransac), Geometry - pinhole camera model - intrinsic and extrinsic camera calibration - tracking, and semantic segmentation for drivable surface estimation</i> <i>Practice- Design perception system using Camera Sensor in MATLAB Automated Driving Tool Box</i>		CO-5 BTL-3
TEXT BOOKS		
1.	<u>Paul F. McManamon</u> , LiDAR Technologies and Systems, SPIE Publications, 2019	
2.	<u>Changzhan Gu</u> , Short-Range Micro-Motion Sensing with Radar Technology, IET, 2019.	
3.	Himanshu Prakash Jain, Anbumani Subramanian “Real-Time Upper-Body Human Pose Estimation Using a Depth Camera” Research Article.	
REFERENCE BOOKS		
1.	Christian Wöhler “3D Computer Vision: Efficient Methods and Applications X. media publishing, 2012.	
2.	Peter J.G. Teunissen, Oliver Montenbruck, Springer Handbook of Global Navigation Satellite Systems, 2017.	

Specialization 3: ENGINE AND VEHICLE TECHNOLOGY

COURSE TITLE	VIBRATION AND NOISE CONTROL				CREDITS	3									
COURSE CODE	EAT51536	COURSE CATEGORY	DE		L-T-P-S	2-0-2-2									
Version	1.0	Approval Details	36 TH ACM		LEARNING LEVEL	BTL-3									
ASSESSMENT SCHEME															
CIA					ESE										
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”				Attendance								
15%	15%	10%	5%		5%	Theory 25%									
						Practical 25%									
Course Description	The students shall develop a basic understanding on automotive vibration and its control and apply on real example cases.														
Course Objective	1. To familiarize on various types of vibration with damping and without damping 2. To develop numerical methods for noise analysis 3. To demonstrate various types of noise and it's measurement and analysis techniques. 4. To identify various sources of noise from automobiles 5. To design various noise controlling techniques														
Course Outcome	Upon completion of this course, the students will be able to 1. Familiarize on various types of vibration with and without damping effects 2. Develop and analyze numerical methods for noise analysis 3. Demonstrate various types of noise and it's measurement and analysis techniques 4. Identify various sources of noise from automobiles 5. Design various noise controlling techniques														
Prerequisite : Design of Machine elements & Basics of Acoustics															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO -2	PSO -3
CO-1	3	1	3	1	3	-	-	-	-	-	2	3	3	1	3
CO-2	2	2	2	3	3	-	-	-	-	-	1	2	2	2	2
CO-3	3	2	1	2	1	-	-	-	-	-	2	3	3	2	3
CO-4	2	1	2	3	3	-	-	-	-	-	1	2	2	1	2
CO-5	3	1	3	3	2	-	-	-	-	-	1	3	2	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO VIBRATION (6L+6P)															
Single degree of freedom, two degree of freedom, free, forced and damped vibrations modeling and simulation studies, model of an automobile, magnification factor, transmissibility, vibration absorber. Two degree of freedom system. Modal analysis.					CO-1 BTL-3										
MODULE 2: NUMERICAL METHODS (6L+6P)															
Approximate methods for determining fundamental frequency, Dunkerleys lower bound, Rayleighs upper bound, Holzer method for closed coupled system and branched system.					CO-2 BTL-3										
MODULE 3: VIBRATION CONTROL TECHNIQUES (6L+6P)															

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.	CO-3 BTL-3
MODULE 4: AUTOMOTIVE NOISE SOURCES (6L+6P)	
Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.	CO-4 BTL-3
MODULE 5: NOISE CONTROL TECHNIQUES (6L+6P)	
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers. Measurement of noise, Acoustic Chambers, Anechoic Chamber, Reverberation chamber, Sound absorbing materials, Sound Absorption and Reflection Coefficients, Noise reduction coefficient, Methods of industrial noise control.	CO-5 BTL-3
BOOKS	
1.	Grover G.K. "Mechanical Vibrations" Nem Chand & Brothers, 2 nd edition, 2007.
2.	Ambekar A.G. "Mechanical Vibrations and Noise Engineering" Prentice-Hall of India, New-Delhi, 2 nd edition, 2006.
REFERENCE BOOKS	
1	Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2010.
2	Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2010.
3	Thomson W.T "Theory of Vibration with Application" CBS Publishers & Distributors, Delhi, 3 rd edition, 1990.
4	Pujara K. "Vibration & Noise for Engineers", Dhanpat Rai & Sons, Delhi, 2nd edition, 1992.
E Resources for Reference	
1.	https://www.pdionline.com/courses/m104/m104.htm
2.	www.springer.com/gp/book/9780857295637
MOOC	
1.	https://archive.nptel.ac.in/courses/112/106/112106225/
2.	https://www.mooc-list.com/course/introduction-advanced-vibrations-coursera

COURSE TITLE	FUEL CELL TECHNOLOGY			CREDITS	3
COURSE CODE	EAT51537	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 TH ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	
15%	15%	10%	5%	5%	
					Theory 25%

														Practical 25%
Course Description	The students shall develop a basic understanding on working of fuel cell and its applications.													
Course Objective	1. To present in-depth knowledge of fuel cell technology 2. To address the underlying concepts, methods and application of fuel cell technology													
Course Outcome	Upon completion of this course, the students will be able to 1. Discuss on various types of Fuel Cells, its construction & working principles. 2. Identify the Fuel Cells for automotive applications. 3. Interpret about the various fuel cell components & its performance characteristics. 4. Gain knowledge about the different types of fuels used in Fuel Cells. 5. Analyze and comparative study of fuel cells with other types of alternate fuels													
Prerequisite : Nil														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	1	2	3	-	3	3	-	-	-	2	3	3	1
CO-2	2	2	2	3	-	2	3	-	-	-	1	2	2	2
CO-3	3	2	1	3	1	-	-	-	-	-	2	3	3	1
CO-4	2	1	2	3	2	2	3	-	-	-	1	2	2	3
CO-5	3	1	3	3	2	3	3	-	-	-	1	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: FUEL CELL TYPES													(6L+6P)	
Introduction - working and types of fuel cell - Polymer Electrolyte Membrane (PEM) Fuel Cells Direct Methanol Fuel Cells, Phosphoric Acid Fuel Cells, Molten Carbonate Fuel Cells, Solid Oxide Fuel Cells, Regenerative Fuel Cells Alkaline Fuel Cells - low, medium and high temperature fuel cell, Liquid and methanol types, Proton exchange membrane fuel cell solid oxide, Hydrogen fuel cells - Thermodynamics and electrochemical kinetics of fuel cells.													CO-1 BTL-3	
MODULE 2: FUEL CELLS FOR AUTOMOTIVE APPLICATIONS													(6L+6P)	
Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems – Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.													CO-2 BTL-3	
MODULE 3: FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE													(6L+6P)	
Fuel cell performance characteristics - Current/voltage, Voltage efficiency and power density, ohmic resistance, Kinetic performance, Mass transfer effects - Membrane electrode assembly components, Fuel cell stack, Bi-polar plate, Humidifiers and cooling plates.													CO-3 BTL-3	
MODULE 4: FUELLING													(6L+6P)	
Hydrogen storage technology - Pressure cylinders, Liquid hydrogen, Metal hydrides, Carbon fibers- Reformer technology - Steam reforming, Partial oxidation, Auto thermal reforming - CO removal, Fuel cell technology based on removal like bio-mass.													CO-4 BTL-3	
MODULE 5: FUEL CYCLE ANALYSIS													(6L+6P)	
Introduction to fuel cycle analysis - Application to fuel cell and other competing technologies like battery powered vehicles, SI engine fueled by natural gas and hydrogen and hybrid electric vehicle.													CO-5 BTL-3	
BOOKS														
1.	Fuel Cells for automotive applications – professional engineering publishing UK. ISBN 1- 86058 4233, 2004.													
2.	Fuel Cell Technology Handbook SAE International Gregor Hoogers CRC Press ISBN, 2003.													
REFERENCE BOOKS														
1	O'Hayre, R.P.,S. Cha, W. Colella, F.B.Prinz, Fuel Cell Fundamentals, Wiley, NY (2006).													
2	Basu,S.(Ed) Fuel Cell Science and Technology,Springer, N.Y.(2007).													
3	Liu, H.,Principles of fuel cells, Taylor & Francis, N.Y. (2006).													

MOOC	
1.	https://archive.nptel.ac.in/courses/103/102/103102015/
2.	https://www.udemy.com/course/hydrogen-powered-fuel-cell-electric-vehicle/

Specialization 4: DESIGN AND MANUFACTURING

COURSE TITLE	COMPUTATIONAL FLUID DYNAMICS				CREDITS	3								
COURSE CODE	EAT51538	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2									
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-5									
ASSESSMENT SCHEME														
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	ESE									
15%	15%	10%	5%	5%	Theory 25%	Practical 25%								
Course Description	This is an introductory course in CFD. In this course, students will be exposed to basics of CFD. Students will gain knowledge on FD/ FV strategy, formulation of the problem and solution technique													
Course Objectives	To provide brief introduction of Computational Fluid Dynamics and application specifically, analysis of fluid mechanics and heat transfer related problems.													
Course Outcomes	1. To understand the underlying theoretical basics of CFD. Use Finite Difference and Finite Volume methods 2. To Illustrate various discretization techniques used to solve PDE. 3. To Apply linearization techniques, boundary conditions, direct and iterative approaches 4. To develop a foundation for understanding the different finite volume numerical schemes for structured and unstructured grids, boundary and initial conditions, linear algebraic and differential algebraic equations solvers 5. To understand the underlying complex phenomenon in turbulent flows and modelling approaches.													
Prerequisites: Basic course on Fluid Mechanics, Thermodynamics and Numerical Methods														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO-1	3	3	2	3	2	2	2	2	2	3	3	3	3	3
CO-2	3	3	2	2	2	2	2	2	2	2	2	2	3	3
CO-3	2	2	3	3	3	1	3	2	1	1	1	2	3	3
CO-4	1	2	1	3	2	3	1	2	2	2	1	2	3	3
CO-5	2	3	3	3	3	3	2	2	2	2	2	2	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction and Governing Equations													(6L+6P)	
Principles of Conservation: Continuity Equation, Navier Stokes Equation, Energy Equation and General Structure of Conservation Equations, Classification Partial differential equations- Parabolic, Hyperbolic and Elliptic equation and Physical Behaviour. LAB: Perform geometry modeling for simple fluid flow problems.													CO-1 BTL-3	
Module 2 – Fundamentals of Discretization													(6L+6P)	

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 Convergence, Consistency, Error and Stability, Accuracy, Boundary conditions, CFD model formulation.		CO-2 BTL-3
LAB- 2D/3D geometry creation; Structured mesh generation; Unstructured mesh generation		
Module 3 – Finite Volume Method		(6L+6P)
1-D unsteady state diffusion problems: implicit, fully explicit and Crank-Nicholson scheme. Finite volume discretization of convection-diffusion problem. Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, Finite volume discretization of two-dimensional convection-diffusion problem. The concept of false diffusion, QUICK scheme, TVD schemes and flux limiter functions.		CO-3 BTL-4
LAB- Develop different types of mesh suited for the accurate capturing of flow field		
Module 4 – Solution Algorithms		(6L+6P)
Discretization schemes for pressure, momentum and energy equations - Explicit and implicit Schemes, First order upwind scheme, second order upwind scheme, QUICK scheme, Algorithm-SIMPLE, SIMPLER and PISO, pressure-velocity coupling algorithms, velocity-stream function approach, solution of Navier-Stokes equations		CO-4 BTL-5
LAB- Develop user defined functions to perform customized simulations.		
Module 5 – Turbulence Modelling		(6L+6P)
Background of Turbulence Flows - Origin of turbulence, irregularity, three dimensional motions; Statistical Description of Turbulence - Kolmogorov hypothesis, scales of turbulence, energy cascading; Turbulent Transport of Moment and Heat - Reynolds decomposition technique, turbulent stresses, Reynolds' analogy, dynamics of turbulence; Turbulence Modelling - eddy viscosity hypothesis, near-wall treatment; Free Shear Flows - Mixing Layer, wakes and Jets; Wall-Bounded Flows - Channel and pipe flows, Reynolds stresses, turbulent boundary layer equations; Advanced Turbulence Modelling Techniques - Large Eddy simulation (LES), Direct Numerical Simulation (DNS), Detached Eddy Simulation (DES) models..		CO-5 BTL-5
LAB-Case Studies		
TEXT BOOKS		
1.	Versteeg, H.K., and Malalasekara, W, “An Introduction to Computational Fluid Dynamics”, The Finite Volume Method, 2007.	
2.	Muralidhar, K., and Sundararajan T. Computational Fluid Flow and Heat Transfer, Narosa Publishing. House (1995).	
3	Patankar, S.V., “Numerical Heat Transfer and Fluid Flow”, Hemisphere Publishing Corporation, 1980.	
REFERENCE BOOKS		
1.	Anderson J.D. Computational Fluid Dynamics, Mc-Graw Hills (1995).	
2.	J H Ferziger and M Peric, Computational Methods for Fluid Dynamics, Springer (2002)	
E BOOKS		
1.	Anderson, D.A., Tannehill, J.C. and Pletcher, R.H. (1997). Computational Fluid Mechanics and Heat Transfer, Taylor & Francis	
2.	Pope, S.B., 2003, Turbulent Flows, Cambridge University Press. ISBN: 0-521-59886- 9.	
MOOC		
1.	https://nptel.ac.in/courses/112105045	
2.	https://www.coursera.org/lecture/modeling-simulation-natural-processes/computational-fluid-dynamics-overview-jTjAc	
3.	https://archive.nptel.ac.in/courses/112/106/112106294/	

COURSE TITLE	LEAN MANUFACTURING AND SIX SIGMA				CREDITS	3								
COURSE CODE	EAT51539	COURSE CATEGORY	DE		L-T-P-S	2-0-2-2								
VERSION	1.0	APPROVAL DETAILS	36 TH ACM		LEARNING LEVEL	BTL-3								
ASSESSMENT SCHEME														
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance	End Semester Examination								
15%	15%	10%	5%		5%	Theory 25% Practical 25%								
Course Description	This is course defines the requirement of the process monitoring, improvement and sustainable development. With respect to the industry and application the respective methods from the six sigma can be applied to obtain the continual improvement and sustainment.													
Course Objectives	1. To demonstrate the overview requirement of the method of six sigma and lean 2. To analyze the process through the tools and techniques of six sigma for the various applications. 3. To apply the methodologies for the processes and to evaluate the results 4. To analyze the challenges in the implementation to the suppliers and the stake holders – six sigma method 5. To demonstrate the effectiveness of the continuous improvement in various types of process.													
Course Outcomes	Upon completion of this course, the students will be able to 1. Apply the method of six sigmas in the respective processes 2. Create the techniques for the application for the effective implementation 3. Analyze the specific methodology with respect to the industry and application 4. Evaluate the limitations and the methods for overcoming the challenges in the processes. 5. Create the continual improvement in the applications and the respective processes													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO-1	3	3	3	3	2	2	2	2	2	2	1	1	3	3
CO-2	3	3	3	3	2	2	2	2	2	2	1	1	3	3
CO-3	3	3	3	3	2	2	2	2	2	2	1	1	3	3
CO-4	3	3	3	3	2	2	2	2	2	2	1	1	3	3
CO-5	3	3	3	3	2	2	2	2	2	2	1	1	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction to six sigma methods and lean manufacturing													(6L+6P)	
Historical Overview – Definition of quality – What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing – assessment questions.													CO-1 BTL-3	
Module 2 – Tools and Techniques Included													(6L+6P)	
Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group													CO-2 BTL-3	

technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.		
Module 3 –Methodology of Six Sigma		(6L+6P)
Design For Six Sigma (DFSS), Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder.		CO-3 BTL-3
Module 4 –Step by Step Implementation and Limitations		(6L+6P)
Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach –implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/internal metrics.		CO-4 BTL-3
Module 5 – Validation of the method and further scope of improvement		(6L+6P)
Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S.		CO-5 BTL-4
TEXT BOOKS		
1.	Michael L.George, David Rowlands, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003	
2.	Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000	
REFERENCE BOOKS		
1.	Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, Author House, 2004	
2.	Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma: A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000	
E BOOKS		
1.	https://leanmanufacturingpdf.com/downloads/lean-manufacturing-pdf-list/	
2.	https://cdn2.hubspot.net/hubfs/3418759/Worximity_Lean_Manufacturing_ebook.pdf	
3.	http://www.advice-manufacturing.com/Lean-Manufacturing-eBook.html	
MOOC		
1.	https://onlinecourses.nptel.ac.in/noc22_ce49/preview	
2.	https://onlinecourses.nptel.ac.in/noc20_mg19/preview	
3.	https://archive.nptel.ac.in/courses/110/105/110105123/	

NON DEPARTMENT ELECTIVES

Semester-IV

Non Department Elective-1

COURSE TITLE	AUTOMOTIVE VEHICLE TECHNOLOGY			CREDITS	3
COURSE CODE	EAT51700	COURSE CATEGORY	NE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					

First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	ESE									
15%	15%	10%	5%	5%	Theory 25%									
					Practical 25%									
Course Description	This course narrates the basic functions, classification and practical demonstration to identify the different vehicle sub systems like classification of transport vehicle, automotive engines, Driveline systems, steering, braking and suspension systems for passenger safety and comfort. Also, the future scope in the modern vehicle technologies.													
Course Objectives	1. To Familiarize various types of Automobiles and Nomenclature 2. To Understand the Working Principles of Automotive Engines and its auxiliary system. 3. To Know the Working Principles of various components of drive line system. 4. To Understand the need of safety and comfort system for automobiles. 5. To Understand the new technologies to meet the future challenges.													
Course Outcomes	Upon completion of this course, the students will be able to 1. Familiarize various types of Automobiles and Nomenclature 2. Understand the Working Principles of Automotive Engines and its auxiliary system. 3. Know the Working Principles of various components of drive line system. 4. Understand the need of safety and comfort system for automobiles. 5. Understand the new technologies to meet the future challenges.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO-1	3	2	-	-	3	2	3	2	3	2	-	-	3	3
CO-2	3	2	-	-	3	2	2	2	3	2	-	-	3	3
CO-3	3	2	-	-	3	2	3	2	3	2	-	-	2	2
CO-4	3	3	-	-	3	2	3	2	3	2	-	-	3	3
CO-5	3	3	-	-	3	2	3	2	3	2	-	-	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – INTRODUCTION													(6L+6P)	
Evolution- Classification of Automobile - General Layout of Automobile- Chassis and Frame- Materials. Practical: 1. Study and measurement of the chassis frames: Heavy duty vehicle & Light duty vehicle Suggested Reading: https://araiindia.com/hmr/Control/AIS/11292016102244AM AIS_053.PDF													CO-1 BTL-3	
Module 2 – ENGINE AND AUXILIARY SYSTEMS													(6L+6P)	
Engines-Classification and Nomenclatures- Compression Ignition Engines and Spark Ignition Engines - Injection and Ignition System- Cooling and Lubrication System - Latest Technology – CRDI, GDI, VVT and Dual Fuel Engines Practical: 1. Dismantling, Study and Assembling of Single cylinder and Multi Cylinder SI Engine 2. Dismantling, Study and Assembling of Single cylinder and Multi Cylinder C I Engine													CO-2 BTL-3	
Module 3 – DRIVELINE SYSTEMS													(6L+6P)	

Clutch – Types and Construction – Gear Boxes- Manual and Automatic –Propeller shaft – Slip Joint – Universal Joints – Differential and Rear Axle- Automatic Transmission, CVT and recent developments. Practical: 1. Dismantle, study and assembling of various clutch assemblies 2. Dismantle, study and assembling of various gear boxes and transfer case 3. Dismantle, study and assembling of various joints and propeller shafts.	CO-3 BTL-3
Module 4 – SAFETY AND COMFORT SYSTEM	(6L+6P)
Braking Systems – Types and Construction- Steering system - Steering Geometry and Types of steering gear box– Suspension systems – types- Antilock Braking System- Power Steering - Air suspension Practical: 1. Dismantle study and assemble of various Steering systems. 2. Dismantle, study and assemble of various Braking systems – including ABS 3. Dismantle, study and assembling of dependent and independent suspension systems	CO-4 BTL-3
Module 5 –FUTURE TRENDS IN AUTOMOTIVE FUELS	(6L+6P)
Future Fuels- Biomass- Alcohols - Hydrogen - Fuel cells- Electric and Hybrid Vehicles Practical: 1. Port timing and Valve timing Diagram 2. Performance test on SI Engine 3. Performance test on C I Engine	CO-5 BTL-3
TEXT BOOKS	
1	Sethi H.M, Automobile Technology, Tata McGraw-Hill-2013
2	Kirpal Singh, Automobile Engineering Vol. 1& 2, Standard Publishers, New Delhi, 2012.
3	Joseph Heitner, Automotive Mechanics, 2 nd edition, East-West Press.
REFERENCE BOOKS	
1	Crouse and Anglin, Automotive Mechanism, 9th Edition. Tata McGraw-Hill.
2	Newton, Steeds and Garet, Motor vehicles, Butterworth Publishers.
3	Srinivasan.S, Automotive Mechanics, 2nd edition, Tata McGraw-Hill, 2013.
4	K.K. Ramalingam, Internal Combustion Engines, Sci-Tech Publications, 2015.
E BOOKS	
1	https://www.sae.org/publications/books/content/bosch10/
2	https://easyengineering.net/internal-combustion-engines-by-v-ganesan/
MOOC	
1.	https://nptel.ac.in/courses/112103262/

COURSE TITLE	ELEMENTS OF MOTORSPORT ENGINEERING			CREDITS	3
COURSE CODE	EAT51701	COURSE CATEGORY	NE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 TH ACM	LEARNING LEVEL	BTL-2
ASSESSMENT SCHEME					
First Periodical	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department	Attendance	End Semester Examination

Assessment			Examination Committee “DEC”											
15%	15%	10%	5%				5%	Theory 25% Practical 25%						
Course Description	This course aims to provide you with a sound understanding of the fundamental scientific, engineering and managerial principles involved in motorsport, and their implementation within a high-performance technology context.													
Course Objectives	1. To understand basics of Motorsports history and its development. 2. To get knowledge on Motorsports competitions. 3. To understand the advancement in race events and race tracks. 4. To understand the basic rules and regulations of racing. 5. To understand the role of motorsports and its carrier growth.													
Course Outcomes	Upon completion of this course, the students will be able to 1. Gain the knowledge on Motorsport Engineering. 2. Familiarize with rules & regulations of various events and competitions in around the globe. 3. Develop the career towards Motorsport Engineering 4. Discuss on the basic rules and regulations of racing 5. Develop the role of motorsports and its carrier growth.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PS O 1	PSO 2
CO-1	3	3	1	3	1	3	-	-	1	-	-	3	1	1
CO-2	3	3	-	3	1	3	-	1	-	-	1	3	2	2
CO-3	3	3	-	3	-	3	2	-	2	-	-	3	1	1
CO-4	-	-	-	-	-	-	-	-	-	-	-	-	2	1
CO-5	-	-	-	-	-	-	-	-	-	-	-	-	1	2
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – INTRODUCTION TO MOTORSPORT ENGINEERING												(6L+6P)		
The history of motorsport Engineering-Review of motorsport Engineering-Pioneers of Motorsport engineering Motorsport technology evolution review- Secrecy in Motorsport engineering												CO-1 BTL-2		
Module 2 – MOTORSPORT COMPETITIONS												(6L+6P)		
A brief look at all the events students can take part to develop their skills - Formula SAE - Baja SAE - SAE Super mileage. Go-Karting, Solar Vehicle and E Bike												CO-2 BTL-2		
Module 3 – PROFESSIONAL MOTORSPORT EVENTS												(6L+6P)		
The various types of professional motorsport events that take place around the world - Cars – Formula One, World rally championship, Touring car championship, GP2, GP3, World Endurance Racing Championship, dirt track racing, NASCAR, Indy Car, Cross Country rallies, drag racing - Motorcycles – Moto GP, Superbike, Endurance, Motocross, Super moto, Freestyle, Trials, Cross-country rallies, Speedway, Board track, drag racing												CO-3 BTL-2		
Module 4 – RULES AND REGULATIONS												(6L+6P)		
All about the most important book for a motorsport engineer – the rule book - About - the world governing bodies of the sport - Why the rule book keeps changing - How to interpret the rule book- Rules for car races - Rules for bikes races.												CO-4 BTL-2		
Module 5 – CAREER IN MOTORSPORT												(6L+6P)		
A sneak peek into all the awesome jobs- Motorsport Engineer Race Driver / Rider - Test Driver / Rider - Design engineer - Race technician -Aerodynamics Engineer - Race official / steward.												CO-5 BTL-2		
TEXT BOOKS														

1.	Basic Motorsport Engineering: Andrew Livesey Publication Date: 17 Feb 2011 ISBN-10: 0750689099 ISBN-13: 978-0750689090
2.	
REFERENCE BOOKS	
1.	Smith's Fundamentals of Motorsport Engineering by Josh Smith Publication Date: 26 April 2013 ISBN-13: 9781408518083 Edition: New edition
2.	Hillier's Fundamentals of Motor Vehicle Technology Book 1Sixth Edition by Alma Hillier Publication
E BOOKS	
1.	www.motorsportwebsites.co.uk / www.motorsportmagazine.comand others.
2.	www.motorsport.com
MOOC	
1.	Mahindra AQ - https://mahindraaq.com/aq-quiz

COURSE TITLE	ENERGY FROM RENEWABLE SOURCES				CREDITS	3								
COURSE CODE	EAT51702	COURSE CATEGORY	NE		L-T-P-S	2-0-2-2								
VERSION	1.0	APPROVAL DETAILS	36 TH ACM		LEARNING LEVEL	BTL-3								
ASSESSMENT SCHEME														
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance	End Semester Examination								
15%	15%	10%	5%		5%	Theory 25% Practical 25%								
Course Description	This course narrates the possibility, availability and method for utilizing the energy from the resources other than the conventional fossil fuel resources. This course is necessitating the utilization of the waste to energy and low cost resources for the energy.													
Course Objectives	1. To create awareness about sources of energy and able to estimate how long the available conventional fuel reserves will last. 2. To learn the fundamental concepts about solar energy systems and devices. 3. To design wind turbine blades and know about applications of wind energy for water pumping and electricity generation 4. To understand the working of OTEC system and different possible ways of extracting energy from ocean, 5. To analyze the feasibility and plan for Biomass energy, mini-micro hydro systems and geothermal energy system													
Course Outcomes	Upon completion of this course the students are able to: 1. Discuss on renewable and non-renewable sources of energy 2. Gain knowledge about working principle of various solar energy systems 3. Understand the application of wind energy and wind energy conversion system 4. Develop capability to do basic design of bio gas plant 5. Interpret the applications of different renewable energy sources like ocean thermal, hydro, geothermal energy etc													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO-2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO-3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO-4	3	3	3	3	-	-	-	-	-	-	-	-	3	3

CO-5	3	3	3	3	-	-	-	-	-	-	-	-	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – INTRODUCTION TO ENERGY STUDIES													(6L+6P)	
Introduction, Energy science and Technology, Forms of Energy, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Roles and responsibility of Ministry of New and Renewable Energy Sources, Needs of renewable energy, Classification of Energy Resources, Conventional Energy Resources , Non- Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario													CO-1 BTL-3	
Module 2 – SOLAR ENERGY													(6L+6P)	
Introduction, Solar Radiation, Sun path diagram, Basic Sun-Earth Angles, Solar Radiation Geometry and its relation, Measurement of Solar Radiation on horizontal and tilted surfaces, Principle of Conversion of Solar Radiation into Heat, Collectors, Collector efficiency, Selective surfaces, Solar Water Heating system, Solar Cookers, Solar driers, Solar Still, Solar Furnaces, Solar Greenhouse. Solar Photovoltaic, Solar Cell fundamentals, Characteristics, Classification, Construction of module, panel and array. Solar PV Systems (stand-alone and grid connected), Solar PV Applications. Government schemes and policies													CO-2 BTL-3	
Module 3 – WIND ENERGY													(6L+6P)	
Introduction, History of Wind Energy, Wind Energy Scenario of World and India. Basic principles of Wind Energy Conversion Systems (WECS), Types and Classification of WECS,Parts of WECS, Power, torque and speed characteristics, Electrical Power Output and Capacity Factor of WECS, Stand alone, grid connected and hybrid applications of WECS, Economics of wind energy utilization, Site selection criteria, Wind farm, Wind rose diagram.													CO-3 BTL-3	
Module 4 – BIOMASS ENERGY													(6L+6P)	
Introduction, Biomass energy, Photosynthesis process, Biomass fuels, Biomass energy conversion technologies and applications, Urban waste to Energy Conversion, Biomass Gasification, Types and application of gasifier, Biomass to Ethanol Production, Biogas production from waste biomass, Types of biogas plants, Factors affecting biogas generation, Energy plantation, Environmental impacts and benefits, Future role of biomass , Biomass programs in India													CO-4 BTL-3	
Module 5 – HYDRO POWER AND OTHER RENEWABLE ENERGY SOURCES													(6L+6P)	
Hydropower: Introduction, Capacity and Potential, Small hydro, Environmental and social impacts. Tidal Energy: Introduction, Capacity and Potential, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy: Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation. Geothermal Energy: Introduction, Capacity and Potential, Resources of geothermal energy													CO-5 BTL-4	
TEXT BOOKS														
1	Twidell, J.W. & Weir, A. Renewable Energy Sources, EFN Spon Ltd., UK, 2006													
2	B. H. Khan, Non-Conventional Energy Resources, , The McGraw Hill													
REFERENCE BOOKS														
1.	G.D. Rai, Non-Conventional Energy Sources, Khanna Publications, New Delhi, 2011.													
2.	Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, OxfordUniversity Press, U.K.													
E BOOKS														

1	https://www.google.co.in/search?q=non+renewable+energy+ebooks+free&sxsrf=APwXEdeKfeXJ48_Zns46TfydC-ujyk8wMw%3A1684469146689&ei=mVvmZOTPKdzp4-EP9cqD0Ao&ved=0ahUKewijkhP7IwID_AhXc9DgGHXXIAKoQ4dUDCA8&uact=5&oq=non+renewable+energy+ebooks+free&gs_lcp=Cgxnd3Mt d2l6LXNlcnAQAzIHCCCEQoAEQCjIHCCCEQoAEQCjIHCCCEQoAEQCjHCCCEQoAEQCjokCAAQRxDWBBCwAzoICCEQFhAeEB1KBAbBGABQ0gFYgQhgygpAXABeACAAaMDiAHOB5IBBzItMS4xLjGYAQCgAQHI AQLAAQE&sclient=gws-wiz-serp
MOOC	
1	https://nptel.ac.in/courses/102104057
2	https://archive.nptel.ac.in/courses/121/106/121106014/
3	https://archive.nptel.ac.in/courses/115/103/115103123/

Basic Terminology and Concepts of IC Engines – Classification- Construction – Working – Engine power and Efficiencies – Performance, emission and combustion characteristics – Case Study.	CO-1 BTL-3
Module 2 – Fuel and Engine Modification	(6L+6P)
Fuels – Properties – Constraints – World Scenario – Future Fuels – Types-Fuel and Engine Modification – Types – Emulsion – Transesterification – Dual Fuel Engines – Case Study.	CO-2 BTL-3
Module 3 – Liquid Fuels	(6L+6P)
Types – Biofuels – Alcohols – Source –Production Techniques – Storage- Properties – Utilization – Challenges – Limitations – Case Study.	CO-3 BTL-4
Module 4 – Gaseous Fuel	(6L+6P)
Types – Biogas – Hydrogen – Source – Production Techniques - Properties – Utilization – Challenges – Limitations – Case Study.	CO-4 BTL-4
Module 5 –Emerging Technologies	(6L+6P)
Emissions Norms – Standards – Fuel – Engine – HCCI – PCCI. GDI – VVT – CRDI – Downsizing – Case Study.	CO-5 BTL-4
TEXT BOOKS	
1. Ganesan V, “Internal Combustion Engines”, Tata McGraw-Hill.	
2. Heywood J. B, “Internal Combustion Engine Fundamentals”, McGraw Hill Book Co. NY.	
3 Mathur M. L and Sharma. R. P, “A Course in Internal Combustion Engines”, Dharpat Rai & Sons.	
REFERENCE BOOKS	
1. Internal Combustion Engine Handbook, 2 nd English Edition, Richard Van Basshuysen, Fred Schaefer SAE International ISBN of 978-0-7680-8024-7	
2. Bosch Automotive Handbook, 10 th Edition Robert Bosch ISBN of 978-0-7680-9567-8	
3 Heldt.P.M. High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta, 2011.Knothe,.	
4 Maleev, V.M., Diesel Engine Operation and Maintenance, McGraw Hill, 2010.	
5 Hydrogen – A fuel for Automatic Engines, Prashukumar G P, ISTE	
6 William.H.Crouse, Automotive Engines, McGraw Hill Publishers, 2014	
7 Tomorrow’s Energy – Hydrogen Fuel Cells and the Prospects for Cleaner Planet, Peter Hoffman, MIT	
E BOOKS	
1. https://myxfpzg.files.wordpress.com/2015/08/robert-bosch-automotive-electronics-handbook-pdf.pdf	
2. http://opac.vimaru.edu.vn/edata/EBook/NH2014/CSDL_CS2014_2/HH0074.pdf	
3 Karthic, S. V., M. Senthil Kumar, G. Nataraj, and P. Pradeep. "Experimental investigations on the influence of hydrogen and LPG mixtures on performance behavior of a mahua bio oil-powered dual fuel engine." International Journal of Green Energy 16, no. 12 (2019): 878-889.	
4 Vinoth Kanna, I., and Pallavi Paturu. "A study of hydrogen as an alternative fuel." International Journal of Ambient Energy 41, no. 12 (2020): 1433-1436.	
5 Ramesohl, Stephan, and Frank Merten. "Energy system aspects of hydrogen as an alternative fuel in transport." Energy policy 34, no. 11 (2006): 1251-1259.	
MOOC	
1. https://nptel.ac.in/courses/112104033	
2. https://nptel.ac.in/courses/112103262	
3 https://onlinecourses.nptel.ac.in/noc22_ch66/preview	

Semester V

Non Department Elective-2

COURSE TITLE		SMART MATERIALS FOR AUTOMOTIVE APPLICATIONS					CREDITS		3					
COURSE CODE		EAT51704	COURSE CATEGORY		NE			L-T-P-S		2-0-2-2				
Version		1.0	Approval Details		36 TH ACM			LEARNING LEVEL		BTL-3				
ASSESSMENT SCHEME														
CIA								ESE						
First Periodical Assessment		Second Periodical Assessment	Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		Theory		Practical			
15%		15%	10%		5%		5%		25%		25%			
Course Description		This course deals with smart materials, types of smart material and application in various fields; shape memory alloy, processing methods and its application in various sector; piezoelectric material, its types, processing and application in the various engineering sector and Magneto Rheological Fluid & Electro Rheological Fluid, its compositions and application in various field												
Course Objective		1. To acquire knowledge on smart materials, types of smart material and application in various fields. 2. To gain knowledge on shape memory alloy, processing methods and its application in various sector 3. To obtain knowledge on piezoelectric material, its types, processing and application in the various engineering sector 4. To acquire knowledge on Magneto Rheological Fluid & Electro Rheological Fluid, its compositions and application in various field 5. To do case study of smart materials in various engineering application												
Course Outcome		Upon completion of this course, the students will be able to 1. Acquire knowledge on smart materials, types of smart material and application in various fields. 2. Gain knowledge on shape memory alloy, processing methods and its application in various sector 3. Obtain knowledge on piezoelectric material, its types, processing and application in the various engineering sector 4. Acquire knowledge on Magneto Rheological Fluid & Electro Rheological Fluid, its compositions and application in various field 5. Case study of smart materials in various engineering application												
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	2	1	1	-	-	-	-	-	-	1	1	2	1
CO-2	3	1	2	2	-	-	-	-	-	-	1	2	3	2
CO-3	2	2	1	1	-	-	-	-	-	-	2	2	2	3
CO-4	3	1	2	1	-	-	-	-	-	-	2	1	3	1

CO-5	2	2	1	2	-	-	-	-	-	-	1	1	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 - INTRODUCTION TO SMART MATERIALS													(6L+6P)	
Define smart material-smart materials Vs other materials -History of smart materials-properties of smart materials –Types of smart materials-advantage and disadvantage of smart materials – application of smart materials													CO-1 BTL-3	
MODULE 2 –SHAPE MEMORY ALLOY													(6L+6P)	
Introduction to shape memory alloy-history of safe memory alloy-working principle of shape memory alloy-processing of shape memory alloys- powder metallurgy processing, sintering, Hot isostatic pressing, metal injection molding - additive processing, selective laser sintering, selective laser melting –advantage and disadvantage of shape memory alloy-application of shape memory alloy													CO-2 BTL-3	
MODULE 3 – PIEZOELECTRIC MATERIAL													(6L+6P)	
Introduction to piezoelectric material-history of piezoelectric material-Piezoelectricity - Physical Phenomena-types of piezoelectric material-piezoelectric sensor -piezoelectric actuators - Processing of Piezoelectric Ceramic Materials-advantage and disadvantage of piezoelectric material-application of piezoelectric material.													CO-3 BTL-3	
MODULE 4 -MAGNETO RHEOLOGICAL FLUID & ELECTRO RHEOLOGICAL FLUID													(6L+6P)	
Introduction to Magneto Rheological Fluid(MRF) & Electro Rheological Fluid(ERF) –Smart fluid-MR material-working of MRF –Material composition of MRF- Preparation of MRF Fluid- Mode of MRF-advantage and disadvantage of MRF-Working of ERF-Material composition of ERF- Mode of ERF-advantage and disadvantage of ERF-Application of both MRF&ERF													CO-4 BTL-3	
MODULE 5 – CASE STUDY ON SMART MATERIAL													(6L+6P)	
Case study of smart material in various field like Automotive , Aeronautical , Aerospace and medical field.													CO-5 BTL-3	
TEXT BOOKS														
1.	Brain Culshaw – Smart Structure and Materials Artech House – Borton. London-1996.													
2.	Engineering Analysis of Smart Material Systems”, Donald J. Leo, Wiley, 2007													
REFERENCE BOOKS														
1	Brian Culshaw, Smart Structures and Materials, Artech House, 2000													
2	Gauenzi, P., Smart Structures, Wiley, 2009													
E Resources for Reference														
1.	https://books.google.co.in/books?id=5NyH0h1OgisC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false													
2.	https://books.google.co.in/books?id=y4ntDwEpJ4YC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false													
MOOC														
1.	https://nptel.ac.in/courses/112/104/112104251/													
2.	https://nptel.ac.in/courses/112/104/112104173/													

COURSE TITLE	INDUSTRIAL SAFETY AND HAZARD MANAGEMENT			CREDITS	3
COURSE CODE	EAT51705	COURSE CATEGORY	NE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36TH ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					

First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination									
15%	15%	10%	5%	5%	Theory 25% Practical 25%									
Course Description	These subjects deal with various industrial safety measures and hazard management													
Course Objectives	1. To identify design process, design of simple equipment 2. To discuss on safety in producing engineering industry 3. To develop environments of occupational hazard, fire safety, dust, environmental safety 4. To design safety in thermal systems 5. To develop safety in transportation													
Course Outcomes	The student will be confident about the safety aspects. 1. Identify design process, design of simple equipment 2. Discuss on safety in producing engineering industry 3. Develop environments of occupational hazard, fire safety, dust, environmental safety 4. Design safety in thermal systems 5. Develop safety in transportation													
Prerequisites: Physics, Chemistry														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	2	-	2	-	-	2	3	-	-	-	-	3	1	2
CO-2	2	-	2	-	-	2	3	-	-	-	-	3	1	2
CO-3	2	-	2	-	-	2	3	-	-	-	-	3	1	2
CO-4	2	-	2	-	-	2	3	-	-	-	-	3	2	1
CO-5	2	-	2	-	-	2	3	-	-	-	-	3	2	1
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
MODULE 1 - INTRODUCTION TO THE DESIGN PROCESS, DESIGN OF SIMPLE EQUIPMENT													(6L+6P)	
Concepts of mechanical failures: Stress - strain diagram (ductile & brittle materials), stress concentration, fatigue failure, Factor of safety, Impact and shock loading, effect of high and low temperatures on strength of materials. Hazard Management: difference between Hazard Disaster Catastrophe, Manmade (fire, release of toxic gases) and Natural Hazards (earthquake, Tsunami), do’s and don’t’s at the time of Hazard occurrence.													CO-1 BTL-3	
Suggested Reading: Design of Simple Equipment - Explosives chemical mixing & cutting knife.														
MODULE 2 - SAFETY IN PRODUCING ENGINEERING INDUSTRY													(6L+6P)	
Safety in use of machinery: Introduction to turning, boring, milling, planning, shaping, grinding, CNC, wood working, arc & gas welding, forging, hot & cold rolling, punching, printing press, Personal safety & material handling devises: Helmets, different hand gloves, aprons, eye protection, pushing and pulling. cranes, forklifts trolleys Safety Regulations: Operating and Support Hazard Analysis (OSHA), Hazard and Operability (HAZOP), safety survey, safety inspection, safety sampling, fault tree analysis, event tree analysis, failure modes and effect analysis. Guarding: Principles of m/c guarding, zero mechanical state (ZMS), definition, policy for ZMS. Suggested Reading: use of personal safety gadgets (different gloves, goggles, ear plugs, eye wash station, static charge devises), instruments.													CO-2 BTL-3	

MODULE 3 - ENVIRONMENTS OF OCCUPATIONAL HAZARD, FIRE SAFETY, DUST, ENVIRONMENTAL SAFETY		(6L+6P)
Environments of Occupational Hazard: Dust – wood working, Glass grinding, powder handling industry, stone crushers, fireworks room layouts. Fire Safety: Fire triangle, fuel classification, difference between combustion & explosion, fire detectors with fire alarm, types of fire extinguishers and their fire -fighting applications, Automatic fire extinguishing systems, static charge prevention, lightening arresters, Environmental safety: Cement dust, toxic gas, explosives, acid manufacture and handling, acid fumes from electro plating, spray paints, Material Safety Data Sheet. Suggested Reading: Centrifugal separator in carpentry section, fireworks – mixing & filling chamber, water spray in stone crusher		CO-3 BTL-3
MODULE 4 - SAFETY IN THERMAL SYSTEMS		(6L+6P)
Steam Power Plant: constructional safety, fuel storage and handling safety system (Fuel - oil, coal, ash, dust), O&M safety, corrosion of tubes, scale formation on tubes, fly ash electric precipitator, Nuclear: LOCA, Sodium and air reaction, failure of control rods, debris collection in flow passage, changing of fuel rods, safe recycle of fuel, safe disposal of used fuel and waste from plant, Refrigeration, Air Conditioning & Cryogenics: over current protection, low & high pressure cut outs, use of gases like Ammonia, + ve & -ve air pressures in rooms, cold burn, safety in cold storages, low temperature properties of metals, handling high pressures. Instruments: safety instruments - like different safety valves, liquid level indicator, fusible plug, pressure gauge etc., importance of instrument calibrations. Suggested Reading: Boiler blasts, three-mile island and Chernobyl accidents		CO-4 BTL-3
Module 5 – SAFETY IN TRANSPORTATION		(6L+6P)
Road Safety: Loss prevention Association death rate data – Seat belt, regulations, automatic seat belt lightener system, collapsible state electronic system for activation air bags, Bumper design for safety, Central locking system. Marine safety: International Marine Organization (IMO), safety of life at Sea (SOLAS) IMO Marine safety committee (MSC) and the IMO marine Environment protection Committee (MEPC) Railway: Fatigue load, NDT of components (Mumbai accident), unmanned rail crossing, earth connection, reasons for derailling accident. Air safety: Fuel tank design (lightening), Concord failure, failure of Apollo13 (O ring), bird hit. Suggested Reading: automotive safety device, railway signals.		CO-5 BTL-4
TEXT BOOKS		
1.	Industrial Safety, Health and Environment Management Systems by Sunil S. Rao & Er. R.K. Jain – 2000	
2.	Industrial Safety Management: Hazard Identification and Risk Control, L. M. Deshmukh, TMH, 2008	
REFERENCE BOOKS		
1.	Industrial Hazard and Safety Handbook, Ralph W King John Magid, Published by Elsevier,	
2.	Handbook of Industrial Hazards and Safety, Paris James (Editor), Clanrye International, 2019	
E BOOKS		
1.	https://link.springer.com/book/10.1007/978-981-10-6328-2	
MOOC		
1.	https://archive.nptel.ac.in/courses/110/105/110105094/	
2.	https://archive.nptel.ac.in/courses/110/105/110105160/	

COURSE TITLE	HYDROGEN ENGINE TECHNOLOGY							CREDITS		3				
COURSE CODE	EAT51706			COURSE CATEGORY		NE			L-T-P-S		2-0-2-2			
VERSION	1.0			APPROVAL DETAILS		36 th ACM			LEARNING LEVEL		BTL-4			
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)				Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance		ESE			
15%	15%				10%		5%		5%		Theory 25%			
											Practical 25%			
Course Description	The course provides an overall insight about utilization of hydrogen for power production. Also provide in-depth analyses about properties and production methods of hydrogen. Testing Methods of Hydrogen in Engines along with its significances will be educated to the learners. Finally, course also provide detailed insights about advance technologies in the domain of Hydrogen Energy Technology													
Course Objectives	1. To examine the need of alternate energy resources and explain the basics of combustion and emission norms. 2. To explain the production methodologies of hydrogen and Compare the properties of hydrogen. 3. To analyze the performance of hydrogen as fuel in IC Engines. 4. To analyze the performance of hydrogen as fuel in Fuel Cell 5. To investigate the challenges and opportunities in hydrogen energy technology.													
Course Outcomes	Upon completion of this course, the students will be able to 1. Explain the need of alternate energy resources and explain the basics of combustion and emission norms. 2. Explain the production methodologies of hydrogen and Compare the properties of hydrogen. 3. Analyze the performance of hydrogen as fuel in IC Engines. 4. Evaluate the performance of hydrogen as fuel in Fuel Cell. 5. Elucidate the challenges and opportunities in hydrogen energy technology.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO-1	3	2	2	2	2	3	3	1	2	1	1	3	3	3
CO-2	3	2	2	2	2	3	3	1	2	1	1	3	3	3
CO-3	3	2	2	3	3	3	3	1	2	1	2	3	3	3
CO-4	3	2	2	3	3	3	3	1	2	1	2	3	3	3
CO-5	3	2	2	3	3	3	3	1	2	1	1	3	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction													(6L+6P)	
Engines - Combustion – Emission Formation – Impact - Need of Alternate Energy Sources. – Types - Availability - Properties - Government Norms and Subsidiary.													CO-1 BTL-3	
Module 2 – Hydrogen as Fuel													(6L+6P)	

Hydrogen pathways - World Scenario – Indian Scenario - Properties of Hydrogen as Fuel- Hydrogen Production Technologies.	CO-2 BTL-3
Module 3 – Engine Technologies	(6L+6P)
Engine Testing - Dual Fuel Engines – Hydrogen Injection – Performance – Emission – Combustion Characteristics.	CO-3 BTL-4
Module 4 – Fuel Cell Technologies	(6L+6P)
Fuel Cell - Thermodynamics - Performance Evaluation – Types - Characterization - System Integration- Application	CO-4 BTL-4
Module 5 – Challenges and Opportunities	(6L+6P)
Properties – Storage – Handling – Emissions. Metal Hydride Storage – Carbon Based Materials for Hydrogen Storage - Hydrogen Powered Vehicles - NOx Control Techniques and Strategies.	CO-5 BTL-4
TEXT BOOKS	
1. Ganesan V, “Internal Combustion Engines”, Tata McGraw-Hill, 2003.	
2. Heywood J. B, “Internal Combustion Engine Fundamentals”, McGraw Hill Book Co. NY, 1989	
3. Mathur M. L and Sharma. R. P, “A Course in Internal Combustion Engines”, Dharpat Rai & Sons, 1993.	
4. Pundir B. P., “IC Engines Combustion and Emissions”, Narosa Publishing House, 2010.	
5. Electrochemical Methods by A.J. Bard and L.R.Faulkner, John Wiley & Sons, Inc.	
REFERENCE BOOKS	
1. Internal Combustion Engine Handbook, 2 nd English Edition, Richard Van Basshuysen, Fred Schaefer SAE International ISBN of 978-0-7680-8024-7	
2. Bosch Automotive Handbook, 10 th Edition Robert Bosch ISBN of 978-0-7680-9567-8	
3. Heldt.P.M. High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta, 2011.Knothe,.	
4. Maleev, V.M., Diesel Engine Operation and Maintenance, McGraw Hill, 2010.	
5. Hydrogen – A fuel for Automatic Engines, Prashukumar G P, ISTE	
6. Fuel Cells: Theory and Applications, Hart A B and Womack G J, Chapman and Hall	
7. Tomorrow’s Energy – Hydrogen Fuel Cells and the Prospects for Cleaner Planet, Peter Hoffman, MIT	
E BOOKS	
1. https://myxfpzg.files.wordpress.com/2015/08/robert-bosch-automotive-electronics-handbook-pdf.pdf	
2. http://opac.vimaru.edu.vn/edata/EBook/NH2014/CSDL_CS2014_2/HH0074.pdf	
3. Karthic, S. V., M. Senthil Kumar, G. Nataraj, and P. Pradeep. "Experimental investigations on the influence of hydrogen and LPG mixtures on performance behavior of a mahua bio oil-powered dual fuel engine." International Journal of Green Energy 16, no. 12 (2019): 878-889.	
4. Vinoth Kanna, I., and Pallavi Paturu. "A study of hydrogen as an alternative fuel." International Journal of Ambient Energy 41, no. 12 (2020): 1433-1436.	
5. Ramesohl, Stephan, and Frank Merten. "Energy system aspects of hydrogen as an alternative fuel in transport." Energy policy 34, no. 11 (2006): 1251-1259.	
6. Koroneos, C., Aris Dompros, George Roumbas, and Nicolas Moussiopoulos. "Life cycle assessment of hydrogen fuel production processes." International journal of hydrogen energy 29, no. 14 (2004): 1443-1450.	
7. Cheng, Xuan, Zheng Shi, Nancy Glass, Lu Zhang, Jiujun Zhang, Datong Song, Zhong-Sheng Liu, Haijiang Wang, and Jun Shen. "A review of PEM hydrogen fuel cell contamination: Impacts, mechanisms, and mitigation." Journal of Power Sources 165, no. 2 (2007): 739-756.	
8. Trimm, David L., and Z. Ilsen Önsan. "Onboard fuel conversion for hydrogen-fuel-cell-driven vehicles." Catalysis Reviews 43, no. 1-2 (2001): 31-84.	
MOOC	
1. https://nptel.ac.in/courses/112104033	
2. https://nptel.ac.in/courses/112103262	
3. https://onlinecourses.nptel.ac.in/noc22_ch66/preview	

COURSE TITLE	E-Mobility: Policy and Business							CREDITS		3				
COURSE CODE	EAT51707			COURSE CATEGORY		NE			L-T-P-S		2-0-2-2			
VERSION	1.0			APPROVAL DETAILS		36 th ACM			LEARNING LEVEL		BTL-3			
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)			Practical Assessment		Observation / lab records as approved by the Department Examination Committee “DEC”			Attendance		ESE			
15%	15%			10%		5%			5%		Theory 25% Practical 25%			
Course Description	The course provides an overall insight about policies of implementing E-Mobility across the globe. Feedback collection and stakeholder involvement with its significances will be educated to the learners. Finally, course also provide detailed insights about supply and demand side policies as well as sustainable ecosystem development for E-Mobility													
Course Objectives	1. To Examine the need of e-mobility and explain the process of feedback collection and stakeholder’s involvement. 2. To Explain the Supply Side Policy Measures and types of Subsidies 3. To Explain Demand side policy measures and regulatory bodies 4. To Analyze the importance in building sustainable charging infrastructure. 5. To Investigate the challenges and opportunities in developing an ecosystem for E-Mobility													
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on the need of e-mobility and explain the process of feedback collection and stakeholder’s involvement. 2. Demonstrate the Supply Side Policy Measures and types of Subsidies 3. Interpret the Demand side policy measures and regulatory bodies 4. Analyze the importance in building sustainable charging infrastructure. 5. Investigate the challenges and opportunities in developing an ecosystem for E-Mobility													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	1	2	1	1	2	3	2	1	1	1	3	3	3
CO-2	3	1	2	1	1	2	3	2	1	1	1	3	3	3
CO-3	3	1	2	1	1	2	3	2	1	1	1	3	3	3
CO-4	3	1	2	1	1	2	3	2	1	1	1	3	3	3
CO-5	3	1	2	1	1	2	3	2	1	1	1	3	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction													(6L+6P)	
EV– Layout – Policy – National – International – Objectives – Stakeholders – Data Collection -Electric Motor Vs Combustion Engine-Comparing drivetrains-sizing of the EV powertrain-Types of electric motors.													CO-1 BTL-3	
Module 2 – Supply Side Policy Measures													(6L+6P)	

Eligibility – Research & Development – Investment Promotion Subsidy – Turnover-based Subsidy – Taxes – Capital Subsidy – Electricity Tax Exemption – Stamp Duty – Subsidy on Cost of Land – Employment & Intellectual Property Creation Incentive-		CO-2 BTL-3
Module 3 – Demand Side Measures		(6L+6P)
Support Measures – Electrification of Vehicular Fleets in the State – Promoting EVs in Manufacturing Facilities– Demand Aggregation – Regulatory Measures & Concessions – Revised Transport Regulation of Electric Vehicles – Private Vehicles, Shared Mobility & Commercial Vehicle Segments – Road Tax/Registration Charges		CO-3 BTL-3
Module 4 – Charging Infrastructure		(6L+6P)
Government Interventions – Tariff for EV Charging – Incentives for Charging Stations – Public Charging Stations – Private e-Aggregator Charging Stations – Incentives for Public Battery Swapping Stations- wireless charging of cars-Battery swap		CO-4 BTL-3
Module 5 – Ecosystem Development		(6L+6P)
Capacity Building & Skilling R&D and Business Incubation Creation of a Circular Sustainable Economy Creation of EV Parks & Vendor Ecosystem Promoting Startups in the EV Sector Investment Facilitation Safety & Awareness Sanctioning & Implementing Agency-Future trends in electric cars-Charging EV from renewables.		CO-5 BTL-3
TEXT BOOKS		
1	Electrical Vehicle Technology. : The Future Towards Eco-Friendly Technology. Prof. Sunil R. Pawar, Notion Press; 1st edition , ISBN-10 : 1685545610	
2	EV Engineering Fundamentals : A beginner’s guide to e-mobility, Ashhar Ahmed Shaikh, Notion Press; 1st edition (12 July 2022), ISBN-13 : 979-8887496443	
REFERENCE BOOKS		
1	Electric Cars: The Ultimate Guide, Keith Chamberlain,2019, Greentech Publishing, ISBN-13 : 978-1916141407	
2	Bosch Automotive Handbook, 10 th Edition Robert Bosch ISBN of 978-0-7680-9567-8	
3	The Future of Electric Vehicles: A Sustainable Solution, Taiwo Ayodele, ISBN-13 : 978-1690837107,2019	
4	Peter Gray, “The Beginners' Guide to RC Electric Cars”, 2011, The Modelers world Series.	
5	David Beeton and Gereon Meyer, “Electric Vehicle Business Models: Global Perspectives ”, 2015.Springer.	
6	Tomorrow’s Energy – Hydrogen Fuel Cells and the Prospects for Cleaner Planet, Peter Hoffman, MIT	
E BOOKS		
1	https://investingintamilnadu.com/DIGIGOV/StaticAttachment?AttachmentFileName=/pdf/poli_noti/TN_Electric_Vehicles_Policy_2023.pdf	
2	https://powermin.gov.in/sites/default/files/uploads/EV/Tamilnadu.pdf	
3	https://www.iea.org/reports/ev-city-casebook-and-policy-guide-2021-edition	
4	https://www.niti.gov.in/sites/default/files/2021-08/HandbookforEVChargingInfrastructureImplementation081221.pdf	
MOOC		
1	https://onlinecourses.nptel.ac.in/noc21_ee112/preview	
2	https://archive.nptel.ac.in/courses/108/103/108103009/	
3	https://onlinecourses.nptel.ac.in/noc22_ee53/preview	

Semester VI

Non Department Elective-3

COURSE TITLE		AUTOMOTIVE SAFETY SYSTEMS								CREDITS		3		
COURSE CODE		EAT51708		COURSE CATEGORY		NE				L-T-P-S		2-0-2-2		
VERSION		1.0		APPROVAL DETAILS		36 TH ACM				LEARNING LEVEL		BTL-4		
ASSESSMENT SCHEME														
First Periodical Assessment		Second Periodical Assessment		Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”				Attendance		ESE		
15%		15%		10%		5%				5%		Theory 25% Practical 25%		
Course Description		This course imparts understanding of role of safety systems in automobiles through technology.												
Course Objectives		- To understand the safety aspects in the vehicle - To gain knowledge about the vehicles structural crashworthiness and crash testing and about the working of vehicle vision safety systems												
Course Outcomes		- To Design and validate the vehicle structure with respect to crash worthiness - To know the various types of safety aspects such as active and passive safety, the active safety components and the working passive safety components such as air bags, seatbelts - To know about various object detection system and working of various comfort, convenience system and environment information system. - To analyze and simulate vehicle in barrier impacts. - To analyze pedestrian safety by use of light measurement and testing												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	2	3	2	1	1	1	1	3	3	3	3	3
CO-2	3	3	1	2	1	2	2	1	2	2	2	2	3	3
CO-3	2	2	3	3	3	1	3	2	1	1	1	2	3	3
CO-4	1	2	1	3	2	3	1	2	2	2	1	1	3	3
CO-5	2	1	2	3	3	3	2	2	2	2	2	1	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1- INTRODUCTION TO VEHICLE SAFETY, STRUCTURAL CRASHWORTHINESS AND CRASH TESTING													(6L+6P)	
Automotive Safety-Active and Passive Safety, Driver Assistance Systems in Automobiles, Definitions and Terminology, Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumple zone, safety sandwich construction. Optimization of Vehicle Structures for Crash Worthiness, Types of Impacts, and Impact With Rebound, Movable Barrier Tests, Roll Over Crash Tests, Behavior of Specific Body Structures in Crash Testing, Photographic Analysis of Impact Tests. LAB- Modeling and Simulation Studies													CO-1 BTL-3	
Module 2 – VEHICLE SAFETY SYSTEMS													(6L+6P)	
The concept of vehicle safety; Need of safety, Active safety: driving safety, conditional safety, perceptibility safety, operating safety-crash safety passive safety: exterior safety, interior,													CO-2 BTL-3	

safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Safety equipment: Seat belt, regulations, automatic seat belt tightened system, Anti-locking braking system (ABS), Speed limiting device (SLD), automatic vehicle stability control, Collapsible steering system, tilt able steering system, air bags, electronic system for activating air bags, bumpers design for safety. Warning devices, indicators, hinges, latches, wipers, horns, etc.		
LAB- Fire detection and suppression system (FDSS), automatic traction control		
Module 3 – VEHICLE INTEGRATION AND NAVIGATION SYSTEM		(6L+6P)
Looking out sensors and Looking in sensors, Intelligent vision system, Vehicle Integration system. Global Positioning System. Vehicle Navigation System. Road Network.V2V, SAE levels of automation LAB- Sensors		CO-3 BTL-3
Module 4 – ERGONOMICS AND HUMAN RESPONSE TO IMPACT		(6L+6P)
Importance of Ergonomics in Automotive Safety, Locations of Controls, Anthropometry, Human Impact Tolerance Determination of Injury Thresholds, Severity Index, Study of Comparative Tolerance, Application of Trauma for Analysis of Crash Injuries. Injury Criteria's and Relation with Crash and Modeling and Simulation Studies in Dummy LAB- Analysis and Simulation of Vehicle in Barrier Impacts		CO-4 BTL-3
Module 5 – LIGHT MEASUREMENTS, TESTING EQUIPMENT, CALIBRATION AND PHOTOMETRIC PRACTICE		(6L+6P)
Basics of Standards and Detectors, Spectral Measurements and Colorimetry, Illuminant Meters and Luminance Meters, Colorimeters. Fundamentals of Equipment Used for Light Measurement in Automotive Field - Gonio- Photometer, Reflecto-Meter, Colorimeter, Integrating Sphere, Types, Application, Coordinates System, Types of Sensors and Working Principle, Construction, Characteristics Etc. Used in Different Equipment. National and International Regulations, Test Requirements and Testing Procedure LAB-Case Studies		CO-5 BTL-4
TEXT BOOKS		
1.	Johnson W and Mamalis A.G., "Crashworthiness of Vehicles", Mechanical Engineering Publications, 2002.	
2.	Ljubo Vlacic, Michel Parent, Fumio Harashima – "Intelligent Vehicle Technologies Theory and Applications" -Butterworth-Heinemann, 2001	
REFERENCE BOOKS		
1.	J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori - "Sensors for Automotive Applications " -WILEYVCH Verlag GmbH & Co. 2003	
2.	ARAI Safety standards	
E BOOKS		
1.	Matthew Huang, "Vehicle Crash Mechanics", CRC Press,2002	
2.	J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori - "Sensors for Automotive Applications " -WILEYVCH Verlag GmbH & Co. 2003	
3.	Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999	
MOOC		
1.	https://onlinecourses.nptel.ac.in/noc20_de06/preview	
2.	https://www.edx.org/course/road-traffic-safety-in-automotive-engineering	

COURSE TITLE	INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEMS			CREDITS	3
COURSE CODE	EAT51709	COURSE CATEGORY	NE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME														
First Periodical Assessment	Second Periodical Assessment			Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”				Attendance		ESE		
15%	15%			10%		5%				5%		Theory 25%		
		Practical 25%												
Course Description		This course provides knowledge on intelligent transport system and vehicle to vehicle technology												
Course Objectives		1. To discuss on Intelligent Transportation Systems (ITS) 2. To demonstrate telecommunications in ITS 3. To design ITS functional areas 4. To describe ITS user needs and services 5. To develop Vehicle-to-Vehicle (V2V) Communications												
Course Outcomes		Upon completion of this course, the students will be able to 1. Discuss on Intelligent Transportation Systems (ITS) 2. Demonstrate telecommunications in ITS 3. Design ITS functional areas 4. Describe ITS user needs and services 5. Develop Vehicle-to-Vehicle (V2V) Communications												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	2	1	3	-	1	-	1	-	1	1	1	1	2
CO-2	2	3	2	2	1	-	1	1	-	2	1	2	2	1
CO-3	1	2	1	2	-	-	-	1	-	1	1	1	1	2
CO-4	2	2	1	2	-	2	1	2	2	2	1	2	2	1
CO-5	2	1	1	2	1	-	-	1	-	1	1	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Introduction to Intelligent Transportation Systems (ITS)													(6L+6P)	
Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.													CO-1 BTL-2	
MODULE 2: Telecommunications in ITS													(6L+6P)	
Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centers (TMC). Vehicle – Road side communication – Vehicle Positioning System.													CO-2 BTL-2	
MODULE 3: ITS functional areas													(6L+6P)	
ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).													CO-3 BTL-3	
MODULE 4: ITS User Needs and Services													(6L+6P)	
ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management. Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.													CO-4 BTL-2	
MODULE 5: Vehicle-to-Vehicle (V2V) Communications													(6L+6P)	

Dedicated short range communications (DSRC) –V2V vs V2I vs V2X vs V2N vs V2P - Importance of ongoing 5G development –GPS receivers and V2V –Laser Illuminated Detection and Ranging (LiDAR) –Inertial navigation systems –Characteristics of a wireless mesh network –V2V and Cybersecurity.		CO-5 BTL-2
TEXT BOOKS		
1.	Kan Paul Chen, John Miles, ITS Handbook: Recommendations for World Road Association (PIARC)	
2.	Sussman, J. M., Perspective on ITS, Artech House Publishers, 2015.	
3.	Dimitrakopoulos, George: Current Technologies in Vehicular Communication, Springer, 2017.	
REFERENCE		
1.	National ITS Architecture Documentation. US Department of Transportation. 2017.	

COURSE TITLE	FUEL CELL TECHNOLOGY										CREDITS	3				
COURSE CODE	EAT51710				COURSE CATEGORY		NE				L-T-P-S		2-0-2-2			
Version	1.0				Approval Details		36 TH ACM				LEARNING LEVEL		BTL-3			
ASSESSMENT SCHEME																
CIA													ESE			
First Periodical Assessment	Second Periodical Assessment				Practical Assessments		Observation / lab records as approved by the Department Examination Committee “DEC”				Attendance					
15%	15%				10%		5%				5%					
		Theory 25%														
		Practical 25%														
Course Description		The students shall develop a basic understanding on working of fuel cell and its applications.														
Course Objective		1. To present in-depth knowledge of fuel cell technology 2. To address the underlying concepts, methods and application of fuel cell technology														
Course Outcome		Upon completion of this course, the students will be able to 1. Discuss on various types of Fuel Cells, its construction & working principles. 2. Identify the Fuel Cells for automotive applications. 3. Interpret about the various fuel cell components & its performance characteristics. 4. Gain knowledge about the different types of fuels used in Fuel Cells. 5. Analyze and comparative study of fuel cells with other types of alternate fuels														
Prerequisite : Nil																
CO, PO AND PSO MAPPING																
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2		
CO-1	3	1	2	3	-	3	3	-	-	-	2	3	3	1		
CO-2	2	2	2	3	-	2	3	-	-	-	1	2	2	2		
CO-3	3	2	1	3	1	-	-	-	-	-	2	3	3	1		
CO-4	2	1	2	3	2	2	3	-	-	-	1	2	2	3		
CO-5	3	1	3	3	2	3	3	-	-	-	1	3	2	3		
1: Weakly related, 2: Moderately related and 3: Strongly related																
MODULE 1: FUEL CELL TYPES													(6L+6P)			
Introduction - working and types of fuel cell - Polymer Electrolyte Membrane (PEM) Fuel Cells Direct Methanol Fuel Cells, Phosphoric Acid Fuel Cells, Molten Carbonate Fuel Cells, Solid Oxide Fuel Cells, Regenerative Fuel Cells Alkaline Fuel Cells - low, medium												CO-1 BTL-3				

and high temperature fuel cell, Liquid and methanol types, Proton exchange membrane fuel cell solid oxide, Hydrogen fuel cells - Thermodynamics and electrochemical kinetics of fuel cells.	
MODULE 2: FUEL CELLS FOR AUTOMOTIVE APPLICATIONS	(6L+6P)
Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems – Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.	CO-2 BTL-3
MODULE 3: FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE	(6L+6P)
Fuel cell performance characteristics - Current/voltage, Voltage efficiency and power density, ohmic resistance, Kinetic performance, Mass transfer effects - Membrane electrode assembly components, Fuel cell stack, Bi-polar plate, Humidifiers and cooling plates.	CO-3 BTL-3
MODULE 4: FUELLING	(6L+6P)
Hydrogen storage technology - Pressure cylinders, Liquid hydrogen, Metal hydrides, Carbon fibers- Reformer technology - Steam reforming, Partial oxidation, Auto thermal reforming - CO removal, Fuel cell technology based on removal like bio-mass.	CO-4 BTL-3
MODULE 5: FUEL CYCLE ANALYSIS	(6L+6P)
Introduction to fuel cycle analysis - Application to fuel cell and other competing technologies like battery powered vehicles, SI engine fueled by natural gas and hydrogen and hybrid electric vehicle.	CO-5 BTL-3
BOOKS	
1.	Fuel Cells for automotive applications – professional engineering publishing UK. ISBN 1- 86058 4233, 2004.
2.	Fuel Cell Technology Handbook SAE International Gregor Hoogers CRC Press ISBN, 2003.
REFERENCE BOOKS	
1	O'Hayre, R.P.,S. Cha, W. Colella, F.B.Prinz, Fuel Cell Fundamentals, Wiley, NY (2006).
2	Basu,S.(Ed) Fuel Cell Science and Technology, Springer, N.Y.(2007).
3	Liu, H.,Principles of fuel cells, Taylor & Francis, N.Y. (2006).
MOOC	
1.	https://archive.nptel.ac.in/courses/103/102/103102015/
2.	https://www.udemy.com/course/hydrogen-powered-fuel-cell-electric-vehicle/

COURSE TITLE	SENSOR TECHNOLOGY & SENSOR FUSION FOR AUTONOMOUS CAR			CREDITS	3
COURSE CODE	EAT51711	COURSE CATEGORY	NE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	End Semester Examination
15%	15%	10%	5%	5%	Theory 25% Practical 25%
Course Description	The goal of the course is to introduce students to the various Sensor technologies and techniques used in autonomous car.				
Course Objectives	The course should enable the student to: 1. To learn the concept of autonomous car and its architecture 2. To learn the concept of an environment perception system 3. To learn the concept of the positioning system 4. To learn the concept of the state estimation and localization 5. To learn the concept of Sensor Fusion and system integration techniques				

Course Outcomes	Upon completion of this course, the students will be able to													
	1. Identify the concept of autonomous car and its architecture													
	2. Interpret the concept of an environment perception system													
	3. Discuss the concept of the positioning system													
	4. Develop the concept of the state estimation and localization													
	5. Design the concept of Sensor Fusion and system integration techniques													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO-1	-	2	-	-	1	-	1	-	-	-	-	-	2	-
CO-2	2	-	-	3	-	-	-	-	-	-	-	-	-	2
CO-3	-	-	2	-	-	2	-	1	-	-	-	-	-	1
CO-4	-	2	-	-	-	-	-	-	-	1	-	-	2	-
CO-5	2	-	-	-	1	-	-	-	-	-	-	-	-	2
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – Introduction to Autonomous Cars and its Architecture													(6L+6P)	
Taxonomy of Driving -Requirements for Perception -Driving Decisions and Actions -Sensors and Computing Hardware -Hardware Configuration Design -Software Architecture - Environment Representation -Safety Frameworks for Self-Driving. Case Studies on Google car – Uber car Practice on MATLAB Automated Driving Tool Box – Introduction													CO-1 BTL-3	
Module 2 – Environment Perception System													(6L+6P)	
Position and orientation Estimation - LIDAR Sensor -LIDAR Sensor Models and Point Clouds - Pose Estimation from LIDAR Data -RADAR Sensor - Sensor Models - Pose Estimation from RADAR Data -Camera and computer vision - Pose Estimation methods. Practice on MATLAB Automated Driving Tool Box using LIDAR/ RADAR/ Camera Sensor													CO-2 BTL-3	
Module 3 – Position Estimation Systems and advanced mechatronics systems													(6L+6P)	
GNSS/INS Sensing for Pose (position and orientation) Estimation -Ultrasonic Sensor -IR Sensor - IMUs -Night Vision Technology – advanced mechatronics system -Intelligent mechatronics - intelligent computation -ECU Architecture - Sensor hardware architecture. Practice on MATLAB Automated Driving Tool Box – Design techniques													CO-3 BTL-3	
Module 4 – State Estimation, Localization and Vehicle control													(6L+6P)	
State Estimation and Optimizing - The Challenges of State Estimation -Path Planning, Autonomy and Decision Making - Vehicle control and Actuation - Longitudinal & Lateral Vehicle Modeling and control Practice on MATLAB Automated Driving Tool Box – Vehicle control logic													CO-4 BTL-3	
Module 5 – Sensors Fusion and Integration of Sensor Data													(6L+6P)	
Fusion Methods in Perception Systems -Fusion Methods in Positioning Systems -Multi sensor Fusion for State Estimation -Sensor Calibration- use of sensor fusion data - Integration of Sensor Data to On-Board Control Systems - Integration Techniques. Practice on MATLAB Automated Driving Tool Box – Testing techniques													CO-5 BTL-4	
TEXT BOOKS														
1.	Jacob Fraden, Handbook of Modern Sensors- Springer, 2nd Edition, 2010.													
2.	Simon M. Sze Wiley, Semiconductor Sensors, Interscience, 3 edition, 2012.													
REFERENCE BOOKS														
1.	Google car –waymo - Uber car – Toyota cars – Volvo cars													
E BOOKS														

1.	https://www.amazon.in/Introduction-Self-Driving-Technology-Artificial-Intelligence
MOOC	
1.	https://www.coursera.org/specializations/self-driving-cars

Semester-VII

Non Department Elective-4

COURSE TITLE	PLANT LAYOUT AND MATERIAL HANDLING				CREDITS	3								
COURSE CODE	EAT51712	COURSE CATEGORY	NE		L-T-P-S	2-0-2-2								
VERSION	1.0	APPROVAL DETAILS	36 th ACM		LEARNING LEVEL	BTL-3								
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessment	Observation / lab records as approved by the Department Examination Committee “DEC”		Attendance	ESE								
15%	15%	10%	5%		5%	Theory 25%								
						Practical 25%								
Course Description	The aim of this course is to empower students on selection of plant location, design plant layout and analyses of suitable material handling equipment’s for the prevailing environment.													
Course Objectives	1. To familiarize on Selection of plant location 2. To acquire the knowledge on design the Plant layout. 3. To obtain knowledge on Material handling Equipment. 4. To gain knowledge on Packing of the Products and storage techniques. 5. To expertise in various analysis of Material Handling Equipment.													
Course Outcomes	Upon completion of this course, the students will be able to 1. Identify the factors on Selection of plant location 2. Acquire the knowledge on design the Plant layout on their own. 3. Obtain knowledge on Material handling Equipment for Their Plant. 4. Gain knowledge on Packing of the Products and storage techniques. 5. Expertise in various analysis of Material Handling Equipment.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	2	-	1	2	-	3	1	-	2	3	-	3	-
CO-2	3	2	-	1	2	-	3	1	-	2	3	-	2	-
CO-3	3	2	-	1	2	-	2	1	-	2	3	-	3	-
CO-4	3	2	-	1	2	-	2	-	-	-	2	-	2	-
CO-5	3	2	-	1	2	-	3	-	-	-	2	-	1	-
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – PLANT LOCATION AND SERVICES						(6L+6P)								

Plant Location: Factors to be considered – Influence of location on plant layout – Selection of plant site – Equipment required for plant operation – Capacity, serviceability and flexibility – Analysis in selection of equipment and space requirements – Buildings. Plant Services: Lighting, heating, ventilation and air conditioning – Utilities supply Practical : Case study on selection of location for an automobile manufacturing plant.	CO-1 BTL-3
Module 2 – PLANT LAYOUT	(6L+6P)
Factors influencing layout – Work center layout – Process and product layout – Tools and techniques for developing a proper layout – Process chart – Flow diagram – Scale model – Machine data – Visualization of layout – Revising and improvising existing plant layout – Balancing of fabrication and assembly lines Practical: Layout design softwares	CO-2 BTL-3
Module 3 – INTRODUCTION TO MATERIAL HANDLING	(6L+6P)
Importance and scope of material handling – Principles of material handling – Planning, operating and costing principles – Types of material handling systems – Factors influencing choice of material handling systems Practical: Field study on material handling devices	CO-3 BTL-3
Module 4 – PACKAGING AND STORAGE	(6L+6P)
Importance of packaging industry – Packaging machinery – Cushion materials – Wrapping and packaging of materials. Stores - planning and design - Storage systems and procedures – Different types and arrangement of storage racks – Automated storage and retrieval systems. Practical; Design of simple storage systems	CO-4 BTL-3
Module 5 – ANALYSIS OF MATERIAL HANDLING	(6L+6P)
Factors in material handling analysis – Motion analysis – Flow analysis – Safety analysis – Equipment cost analysis – Palletization analysis – Analysis of operation Practical: Case study on safety measures.	CO-5 BTL-3
TEXT BOOKS	
1.	Plant Layout & Material Handling G K Agarwal, Publisher: Jain Brother, 2017
REFERENCE BOOKS	
1.	Dougals Considine, Standard Handbook of Industrial Automation, Chapman & Hall, 2012
2.	Immer, Material Handling - McGraw Hill., 2007
3	James Apple, Plant Layout and Material Handling - John wiley, 1991
4	Rudenvkov, Material Handling Equipment -Peace Publishers, 1984
E BOOKS	
1.	https://www.smartworld.com/notes/plant-layout-material-handling-notes-pdf-plmh-notes-pdf
2.	http://www4.ncsu.edu/~kay/Material_Handling_Equipment.pdf
MOOC	
1.	https://www.mooc-list.com/course/materials-and-materials-processing-saylororg
2.	https://www.scl.gatech.edu/education/professional-education/course/mh101

COURSE TITLE	ELECTRIC VEHICLE TECHNOLOGY -TWO AND THREE-WHEELER			CREDITS	3
COURSE CODE	EAT51713	COURSE CATEGORY	NE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					

First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessment	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination									
15%	15%	10%	5%	5%	Theory 25%									
					Practical 25%									
Course Description	This course will enable the students to develop students’ skills making them competent and a flag ship Engineer in the EV market.													
Course Objectives	1. To recall concepts of electric vehicle & performance of electric vehicles. 2. To identify Battery Technologies 3. To recognize on motor and controllers 4. To describe the charging technologies 5. To evaluate the troubleshooting techniques													
Course Outcomes	Upon completion of this course, the students will be 1. Recall concepts of electric vehicle & performance of electric vehicles. 2. Identify Battery Technologies 3. Recognize on motor and controllers 4. Describe the charging technologies 5. Evaluate the troubleshooting techniques													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO-1	2	0	0	0	1	0	0	0	0	0	0	0	1	1
CO-2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
CO-3	0	0	0	0	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	0	1	0	0	0	0	0	0	0	1	2
CO-5	0	0	3	0	1	0	0	0	0	0	0	0	3	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – ELECTRIC VEHICLES													(6L+6P)	
Electric Vehicle – History, Impact on Environment – Well to Wheel concept, Future of EV. Basic principal and components of an Electric Vehicle, HEV, PHEV													CO-1 BTL-3	
Module 2 – BATTERY TECHNOLOGY													(6L+6P)	
Terminology and Description about Integral part of a BEV, Battery Technology and Innovation in Automotive Batteries for Dynamic Applications.													CO-2 BTL-3	
Module 3 – MOTOR AND CONTROLLERS													(6L+6P)	
Propulsion System – Traction Motor / Hub Motor, Battery Management System and Electronics Controller													CO-3 BTL-3	
Module 4 – CHARGING TECHNOLOGY													(6L+6P)	

EV Charging – External and On Board Chargers. Various Methods of Charging.		CO-4 BTL-3
Module 5 – TROUBLESHOOTING		(6L+6P)
Basic Troubleshooting, Fault Tree Analysis (FTA)		CO-5 BTL-4
TEXT BOOKS		
1.	Longo, Stefano, et al. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles. United States, CRC Press, 2018.	
2.	James Larminie and John Lory, “Electric Vehicle Technology-Explained”, John Wiley & Sons Ltd., 2013.	
REFERENCE BOOKS		
1.	Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680-9567-8.	
2.	Tom Denton., “Electric and Hybrid Vehicles”2020.	
E BOOKS		
1.	https://shorturl.at/ahvAJ	
2.	https://shorturl.at/arxzH	
MOOC		
1.	https://elearn.nptel.ac.in/shop/iit-workshops/completed/e-mobility-and-electric-vehicle-engineering/	
2.	https://nptel.ac.in/courses/108106170	

COURSE TITLE	INTRODUCTION TO SELF-DRIVING CARS			CREDITS	3
COURSE CODE	EAT51714	COURSE CATEGORY	NE	L-T-P-S	2-0-2-2
VERSION	1.0	APPROVAL DETAILS	36 th ACM	LEARNING LEVEL	BTL-5
ASSESSMENT SCHEME					
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessment	Observation / lab records as approved by the Department Examination Committee “DEC”	Attendance	End Semester Examination
15%	15%	10%	5%	5%	Theory 25% Practical 25%
Course Description	This course will provide complete knowledge to the undergraduate students on Understand commonly used hardware used for self-driving cars , Identify the main components of the self-driving software stack, Program vehicle modelling and control , Analyze the safety frameworks and current industry practices for vehicle development				
Course Objectives	1. To impart the knowledge on Self-Driving Hardware and Software Architectures 2. To educate about condition of Object Detection in an Urban Environment 3. To impart the knowledge on Sensor Fusion & Perception 4. To instruct the knowledge on Localization and Planning 5. To educate about Control & Trajectory Tracking for Autonomous Vehicles				
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on Self-Driving Hardware and Software Architectures 2. Identify Object Detection in an Urban Environment 3. Develop the Sensor Fusion & Perception 4. Discuss the Localization and Planning 5. Develop the Control & Trajectory Tracking for Autonomous Vehicles				

Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO-1	3	3	2	2	2	1	1	-	-	-	1	-	3	1
CO-2	3	2	2	3	2	1	-	-	-	-	-	-	3	2
CO-3	2	3	3	2	1	1	1	-	-	-	-	-	2	2
CO-4	2	2	3	2	1	1	-	-	-	-	1	-	3	3
CO-5	3	3	3	3	2	1	-	-	-	-	1	-	2	3
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module I – Introduction													(6L+6P)	
The Requirements for Autonomy- Self-Driving Hardware and Software Architectures Safety Assurance for Autonomous Vehicles- Vehicle Longitudinal Control- Vehicle Lateral Control													CO-1 BTL-2	
Module II – Computer Vision													(6L+6P)	
Object Detection in an Urban Environment - The Machine Learning Workflow - Sensor & Camera Calibration - From Linear Regression to Feedforward Neural Networks - Image Classification with Convolutional Neural Networks - Object Detection in Images													CO-2 BTL-2	
Module III – Sensor Fusion													(6L+6P)	
Introduction to Sensor Fusion & Perception - The Lidar Sensor- 3D Object Detection - 3D lidar point clouds - Kalman Filters - Extended Kalman Filters - Multi-Tracking Tracking													CO-3 BTL-3	
Module IV – Localization and Planning													(6L+6P)	
Introduction to Localization- Markov Localization- Creating Scan Matching Algorithms- Utilizing Scan Matching in 3D- Scan Matching Localization - Motion Planning & Decision Making for Autonomous Vehicles - Behavior Planning - Trajectory Generation - Motion Planning - a decision making framework to plan a vehicle’s motion in an urban environment													CO-4 BTL-2	
Module V – Control & Trajectory Tracking for Autonomous Vehicles													(6L+6P)	
Control & Trajectory Tracking for Autonomous Vehicles – PID Control PID and MPC for trajectory tracking using the PID controller - controller with non-linear dynamics - Recognize the observation of the state of the vehicle (position, velocity), the action (steering, accelerator, brake) and the possible perturbations													CO-5 BTL-3	
TEXT BOOKS														
1.	Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS													
2.	Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies and Disruptions: Updated and Expanded Second Edition 2019													
REFERENCE BOOKS														
1.	Andreas Herrmann and Johann Jungwirth , Inventing Mobility for All: Mastering Mobility-as-a-service With Self-driving Vehicles 2022													
E BOOKS														
1.	Shaoshan Liu , Liyun Li , Jie Tang , Shuang Wu , Creating Autonomous Vehicle Systems , Morgan & Claypool Publication 2020													
2.	Sreevatsan Bhaskaran , Kai Zhou , Andrew Baab , Ronald Calhoun “ Autonomous Vehicle Lidar: A Tutorial”Kindle													
MOOC														
1.	https://www.coursera.org/learn/intro-self-driving-cars													
2.	https://www.udacity.com/course/self-driving-car-engineer--nd0013													

COURSE TITLE		AUTOMOTIVE AIRCONDITIONING AND CLIMATE CONTROL								CREDITS		3		
COURSE CODE		EAT51715			COURSE CATEGORY		NE			L-T-P-S		2-0-2-2		
VERSION		1.0			APPROVAL DETAILS		36 th ACM			LEARNING LEVEL		BTL-3		
ASSESSMENT SCHEME														
First Periodical Assessment (Theory)		Second Periodical Assessment (Theory)		Practical Assessment		Observation / lab records as approved by the Department Examination Committee “DEC”				Attendance		End Semester Examination		
15%		15%		10%		5%				5%		Theory 25% Practical 25%		
Course Description		To enable the students gain knowledge on Automotive air conditioning, Electronic climate control and Air conditioning service.												
Course Objectives		The course should enable the students to: 1. To Know about the automotive air conditioning fundamentals. 2. To understand the concepts and components of automotive cooling and heating systems 3. To learn about the refrigerants and handling of refrigerants. 4. To Know the working of automotive sensors used for climate and temperature control. 5. To Know about the servicing of automotive air conditioning system.												
Course Outcomes		Upon completion of this course, the students should be able to: 1. Familiarize on fundamentals of automotive air conditioning systems. 2. Gain knowledge on the concepts and components of automotive cooling and heating systems. 3. Acquire the knowledge on refrigerants and its handling. 4. Attain the knowledge on working of automotive sensors for climate and temperature control. 5. Familiarize on servicing of automotive air conditioning system.												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	2	3	1	2	-	2	-	-	1	1	1	1
CO-2	3	1	2	1	1	1	-	1	-	-	1	1	2	1
CO-3	3	1	2	1	1	1	-	2	-	-	2	2	1	2
CO-4	3	1	2	1	1	1	-	1	-	-	1	1	1	1
CO-5	3	1	2	1	1	1	-	1	-	-	2	1	2	2
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated														
Module 1 – AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS												(6L+6P)		
Introduction to Heating, Ventilation and Air Conditioning- Environmental Concerns- Ozone layer depletion- Location of air conditioning components in a car – Schematic layout of a vehicle refrigeration system. Psychrometry – Basic terminology and Psychrometric mixtures- Psychrometric Chart- Related simple basic problems												CO-1 BTL-3		
Module 2 – AUTOMOTIVE COOLING AND HEATING SYSTEM												(6L+6P)		
Vehicle Refrigeration System and related problems- Fixed thermostatic and Orifice tube system- Variable displacement thermostatic and Orifice tube system- Vehicle air conditioning operation Types of compressor- Compressor Clutches- Compressor Clutch electrical circuit- Compressor lubrication- Condensers- Evaporators- Expansion devices-												CO-2 BTL-3		

Evaporator temperature and pressure controls- receiver-drier- Accumulators- refrigerant hoses, Connections and other assemblies- Heating system		
Module 3 – REFRIGERANT		(6L+6P)
Different types of sensors and actuators used in automatic temperature control- Automotive air conditioning manual control system, auto temperature control system, Automotive climate control system.		CO-3 BTL-3
Module 4 – AUTOMOTIVE ELECTRONIC CLIMATE AND TEMPERATURE CONTROL		(6L+6P)
Different types of sensors and actuators used in automatic temperature control- Automotive air conditioning manual control system, auto temperature control system, Automotive climate control system.		CO-4 BTL-3
Module 5 – AIR CONDITINING SERVICE		(6L+6P)
Temperature measurements – Refrigerant recovery, recycle and charging-system flushing, Retrofitting – Replacement and adjustment of compressor components		CO-5 BTL-3
TEXT BOOKS		
1.	Steven Daly- “Automotive Air –Conditioning Climate Control Systems” - Butterworth – Heinemann – Elsevier Publications -2011.	
2.	William H. Crouse and Donald I. Anglin - “Automotive Air conditioning” - McGraw Hill Inc. - 1990.	
REFERENCE BOOKS		
1.	Boyce H.Dwiggins - “Automotive Air Conditioning” - Delmar – 2002.Mitchell information Services, Inc - “Mitchell Automatic Heating and Air Conditioning Systems” - Prentice Hall Ind. – 1989	
2.	Paul Weiser - “Automotive Air Conditioning” - Reston Publishing Co., Inc., - 1990	
E BOOKS		
1.	https://www.elsevier.com/books/automotive-air-conditioning-and-climate-control-systems/daly/978-0-7506-6955-9	
2.	https://link.springer.com/book/10.1007/978-3-319-33590-2	
MOOC		
1.	https://nptel.ac.in/courses/112107208	
2.	https://www.edx.org/course/distribution-and-control-of-heat-cold-and-air-flows-in-buildings	

MANDATORY COURSES I

COURSE TITLE	INTRODUCTION TO WOMEN AND GENDER STUDIES			CREDITS	Non Credit Course
COURSE CODE	GGE51011	COURSE CATEGORY	MC	L-T-P-S	3--0-0-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment	Second Periodical Assessment	Seminar/Assi gnments/Proj ect	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”	Attendance	
15%	15%	10%	5%	5%	

Course Description	This course has been introduced in the light of NEP-2022. It is a mandatory course. The idea is to sensitize the student in understanding gender and women and issues relating to gender in general and women in particular. To dispel ‘stigma’ shun ‘social taboos’ and to ensure break the glass ceiling. Change in perceptions through knowledge is the object of this course.													
Course Objective	1. To understand the concept of Gender – norms- theories – types etc. 2. To know about Feminism – and the types – jurisprudence of feminism. 3. To have an insight into health and legal issues- specific to women – Social barriers. 4. To make the students – gender sensitized- to shun ‘stigma’ and ‘social taboos’													
Course Outcome	Upon completion of this course, the students will be able to 1. enumerate the basis of gender norms and related theories. 2. sensitize on issues relating to gender -orientation- issues therein. 3. appraise the concept of feminism – as a doctrine. 4. classify the types of feminism and highlight the essential features of them 5. summarise women related laws and connect to women centric issues in societal arena													
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	-	-	-	-	-	-	2	3	2	2	-	1	-	-
CO-2	-	-	-	-	-	-	2	3	2	2	-	1	-	-
CO-3	-	-	-	-	-	-	2	3	2	2	-	1	-	-
CO-4	-	-	-	-	-	-	2	3	2	2	-	1	-	-
CO-5	-	-	-	-	-	-	2	3	2	2	-	1	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
Module 1: Basis of Gender norms and theories (9L)														
Key concepts in Gender studies - Gender and Sexuality, Sex and Gender, Gender and Socialist theory, Gender and Social order Matriarchy and Patriarchy - Women’s Movements – Contemporary Debates- “Mee Too’ - National Commission for Women.													CO-1 BTL-3	
MODULE 2: Types of gender (9L)														
Types of gender – 1. Masculine, 2, Feminine, 3, Transgender, 4, Trans-Sexuality, 5, Bi-Sexuality, 6. Inter Sex													CO-2 BTL-3	
MODULE 3: Sexual Orientation (9L)														
Hetro-Sexuality, Homosexuals , 1, Lesbian and their "ism" , 2, Gays and their "Theory", Trans Sexulism , BI - Sexualism													CO-3 BTL-3	
MODULE 4: Introduction to Feminism (9L)														
Feminism Theory, Types of Feminism (More than 12 feminisms) , 1, Social Feminism 2,Radical Feminism , 3, Black Feminism , 4, Dalit Feminism , 5, Queer Theory -													CO-4 BTL-3	
MODULE 5: Women, Health and Law (9L)														
Health – Life Cycle Approach- Health Status – Reproductive Rights-Sex Ratio - Women have always Glass Ceiling,													CO-5 BTL-3	

Women Rights as Human Rights- Constitution and Women – Gender Equality – Discrimination- Personal Laws- Family Courts – Crime Against Women-Children-Sexual Harassment at Work Place Act-2013. Human Trafficking - Women as secondary to men in social context / order, Women centric issues in Societal arena		
TEXT BOOKS		
1.	Mamatha Rao – ‘Law Relating to Women and Child’- EBC Publishers, Lucknow	
2.	‘Feminist Jurisprudence’- Rosanne Kennedy, 1993	
3.	Sexual Harassment and Violence against Women- Charles V. Dale	
4.	Sexual Harassment of Working Women- Catharine Mackon	
References		
1	Feminist Legal Theory- Rosanne Kennedy, 1993	
2	Sexual Harassment of Women at Workplace- R.C. Jiloha, 2021	
3	Human Trafficking- Virendra Mishra, 2013	
E Resources		
1.	Theory of Feminism- https://en.wikipedia.org/wiki/Feminism	
2.	Sexual Harassment of Women at Workplace- https://www.legalservicesindia.com/article/2114/Sexual-Harassment-of-Women-at-Workplace.html	
3.	Human Trafficking- https://www.unodc.org/unodc/en/human-trafficking/human-trafficking.html	

COURSE TITLE		PUBLIC AND PERSONAL ADMINISTRATION			CREDITS	Non Credit Course
COURSE CODE		GGE51012	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2
Version	1.0	Approval Details		36th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME						
First Periodical Assessment	Second Periodical Assessment	Seminar/Assignments/Project	Surprise Test / Quiz etc.,	Attendance	ESE	
15%	15%	10%	5%	5%	50%	

Course Description	Public Administration has gained immense importance since the emergence of the administrative state. In Ancient Greek, Roman and Indian political system gave more importance to the concept of Administration. Kautily’s “Arthasathra” contributed large scale in the administrative system; it deals every aspect of the state and its relation to subjects. Public Administration is state mechanism. In every Political System, administration have a significant role.														
Course Objective	1. To understand the concept and importance of Public Administration. 2. To analyze the Bases and types of Organization. 3. To examine the types and functions of executive. 4. To identify the Principles of Management. 5. To evaluate the control over Public Administration.														
Course Outcome	Upon completion of this course, the students will be able to 1. acquire knowledge of public administration. 2. summarize the administrative principles of management. 3. Review the salient features of different theories of administration. 4. Enumerate the roles and responsibilities of District administration and Panchayati raj 5. Identify the societal needs and recommend the strategies for administration of public financial funds.														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	P O -1	P O -2	P O -3	P O -4	P O -5	P O -6	P O -7	P O -8	P O -9	P O - 10	P O - 11	P O - 12	PS O-1	PS O-2	
CO-1	-	-	1	-	-	3	1	1	1	1	2	-			
CO-2	2	2	-	-	-	3	-	1	1	1	2	2			
CO-3	-	-	-	-	-	3	1	2	1	1	2	-			
CO-4	-	-	-	-	-	3	2	3	2	2	2	2			
CO-5	2	2	3	-	-	3	2	3	2	2	2	2			
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: Components of Public Administration													9 Hours		
Meaning, Nature and Scope of Public Administration – Public Administration and Private Administration–Public Administration Arts, Science or Both–Public Administration and Its Relations with Other Social Sciences – New Public Administration- Classical & Neo-Classical Theories of Administration.														CO-1	BTL-2
MODULE 2: Principles of Organization													9 Hours		
Meaning, Nature, Scope and Importance of Organization-Types and kinds of organization - Bases of organization – Steps in Organizational Process- Principles of Organization – Hierarchy- Span of control – Unity of Command – Delegation of Authority – Co-Ordination- Integration Vs. Disintegration – Centralization Vs. Decentralization.														CO-2	BTL-2

MODULE 3: Theories Of Administration		9 Hours
Scientific management (Taylor and movement)- Classical theory- Fayol,Urwick and others- Bureaucratic theory- Max Weber- Ideas of Mary Parker Follett- C.I. Barnard- Behavioural Approach - Systems Approach		CO-3 BTL-3
MODULE 4: District Administration And Panchayati Raj		9
Hours		
District Administration- Block Administration- Constitutional Body under 73rd and 74th Constitutional Amendment- Planning and Development- Rural and Urban		CO-4 BTL-3
MODULE 5: Financial Administration		9
Hours		
Budget concept and forms - Formulation - Enactment of Budget - Execution of Budget - Deficit Financing- Public Debt		CO-5 BTL-3
TEXTBOOKS		
1	Avasthi, A. and Maheswari, S.R.- Public Administration, Laxshmi Narain Publications, 2017.	
2	Dr.G. Venkatesan, Public Administration, VC Publishers, Rajapalayam,2009.	
3	Mohit Bahattacharya, New Horizons of Public Administration, Macmillan Publishers, 2002	
REFERENCE BOOKS		
1	Shriram Maheswari, Administrative Theory: An Introduction, New Delhi, Macmillan India Ltd.,1984.	
2	Vishnoo Bhagwan and – Public Administration, Chand & co., New Delhi1994	
3	Bhambhri, C.P – Public administration – Theory and Practice, Jain Prakash, Nath&co., Meerut, 2002.	
E BOOKS		
1	Sapru, Administrative Theories and Management Thought, Prentice Hall of India, New Delhi, 2005.	
2	Sharma. M. P.: Public Administration in theory and practice, Kithab Mahal, Allahabad ,2006.	

COURSE TITLE	CONSTITUTION OF INDIA			CREDITS	Non Credit
COURSE CODE	GGE51013	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2
Version	1	Approval Details	37 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment	Second Periodical Assessment	Seminar/Assignments/Project	Surprise Test / Quiz etc., as approved by the	Attendance	

			Department Examination Committee “DEC”											
15%	15%	10%	5%				5%	50%						
Course Description	The very purpose of the course is to learn basic law of the land- to know about constitutional values- to carry our constitutional legacy and to imbibe constitutional discipline. To make the student as an informed citizen about his rights and duties expecting a vibrant role in democratic polity of the nation.													
Course Objective	1. To understand the Constitution and Governance of our country. 2. To inspire the students towards -Constitutionalism and its core values 3. To imbibe the values cherished in our Constitution.													
Course Outcome	Upon completion of this course, the students will be able to 1. summarize the basic notions on which the Indian Constitution is based. 2. appraise the functioning of democracy and related systems in place. 3. classify the center and state relations and various Constitutional forums. 4. identify and discuss upon Governor’s rule and related amendments 5. interpret Indian Polity and its challenges for modern India													
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO -1	PSO -2
CO-1	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-2	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-3	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-4	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-5	-	-	-	-	-	2	2	2	2	1	-	1	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
Module 1: Indian Constitution and Governance									(9L)					
Constitution – salient features, Preamble, - Core values – Democratic - Secular, Socialist, Republic, Sovereign, - Basic structure – Constitutional Morality – Federal Features – Fundamental Rights – Fundamental duties													CO-1 BTL-3	
MODULE 2: Democracy – in functioning									(9L)					
Democracy- Elections - Union Government- State Governments - Systems in place – Legislative- Executive- Judiciary- Constitutional Bodies: Election Commission – UPSC- Controller and Auditor General of India.													CO-2 BTL-3	
MODULE 3: Center -State Relations									(9L)					
Legislative powers of the Central Government – State Government – Center-State Relations – Roll of Governor - Niti Ayog – National Integration Council													CO-3 BTL-3	
MODULE 4: Emergency – and Amendments									(9L)					
Governors Rule – National Emergency – Financial Emergency- Constitutional Amendments – 42 nd Amendment - Procedures- Number of Amendments													CO-4 BTL-3	
MODULE 5: Indian Polity									(9L)					
Roll of the Civil Society –Roll of the Youth - – Major Challenges before the nation - Political parties – Programs- in the Country – Indian polity at cross roads.													CO-5 BTL-3	
TEXT BOOKS														
1.		M.P. Jain <i>Indian Constitutional Law</i> , Wadhwa & Co. 2005												
2.		‘Indian Parliament’ –National Book Trust of India publications – New Delhi , 2007												

3.	'Indian Judiciary' - National Book Trust of India publication., 2013
REFERENCES	
1	Constitution of India – visit Union Ministry of Law and Justice website – for latest text.
2	Lectures on Administrative Law – C.K. Takwani, 2021
3	Separation of Powers and Independence of Judiciary- Steve Cann, 2013.
E Resources for Reference	
1.	Constitution of India- Administrative & Adjudicatory process- https://www.strath.ac.uk/research/subjects/law/constitutionaladministrative-law/
2.	Lectures on Administrative Law- http://msrlawbooks.in/file/ADMINISTRATIVE_LAW_FF.pdf
3.	Separation of powers & Independence of Judiciary- https://blog.ipleaders.in/separation-of-powers-and-its-relevance/

COURSE TITLE		LAW FOR ENGINEERS							CREDITS			Non Credit			
COURSE CODE		EGE51006		COURSE CATEGORY			MC			L-T-P-S			3-0-0-2		
Version		1.0		Approval Details			36 th ACM			LEARNING LEVEL			BTL-3		
ASSESSMENT SCHEME															
CIA													ESE		
First Periodical Assessment		Second Periodical Assessment		Seminar/Assignments /Project			Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC””			Attendance					
15%		15%		10%			5%			5%		50%			
Course Description		Every one of us should know the Law of the land. This is truer when it comes to engineers, wherein they are expected to work in a legal environment. Basic knowledge about the legal systems, the redressal mechanism in place. Legal knowledge will help them to start their own enterprise/startup/and also when it comes to IPR relate issues.													
Course Objective		1. To understand the Constitution and Governance of our country. 2. To apprise the students of their rights - local to national redressal mechanism. 3. To have an insight into general laws in general, labour and employment law in particular. 4. To familiarize with intellectual property laws and practices.													
Course Outcome		Upon completion of this course, the students will be able to 1. Classify the basic concepts of Indian Constitution, Governance and the role of citizens. 2. acquire knowledge in significant legislations that affect their lives. 3. enumerate the laws that governs corporate and business world along with legislations that govern management – worker relations. 4. relate to Intellectual Property Rights and related aspects.													
CO, PO AND PSO MAPPING															
CO	PO - 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO -1	PSO -2	
CO-1	-	-	-	-	-	2	2	2	2	1	-	1	-	-	
CO-2	-	-	-	-	-	2	2	2	2	1	-	1	-	-	
CO-3	-	-	-	-	-	2	2	2	2	1	-	1	-	-	
CO-4	-	-	-	-	-	2	2	2	2	1	-	1	-	-	

CO-5	-	-	-	-	-	2	2	2	2	1	-	1	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
Module 1: Indian Constitution and Governance (9L)														
Constitution – salient features, Preamble, - Fundamental Rights and duties. Democracy- Elections Union Government- State Governments – Systems in place - Judiciary- the Supreme Court and High Courts, Good Governance.												CO-1 BTL-3		
MODULE 2: Significant Legislations (9L)														
Consumer Protection Act -2019; Right to information Act 2005. Provident Fund Act – ESI – Employment (Standing Orders) Act 1946 Maternity Benefit Act-2017, Labor Codes- Courts												CO-2 BTL-3		
MODULE 3: Industrial, Corporate and Labour laws (9L)														
Business Laws in general – Partnership Act - Companies Act – 2013- Private and Public Limited Companies, LLP, OPC, Corporate Governance – Directors position.												CO-3 BTL-3		
MODULE 4: Laws related to IPR (9L)														
Introduction to IPR – meaning and scope, Patents- Copy Right – Trade Marks – Industrial Design- GI – Trade Secrets – WIPO.												CO-4 BTL-3		
MODULE 5: Law of Contracts (9L)														
Essentials of a Contract – Enforceability. Various Legal forums that provide relief in various matters.												CO-5 BTL-3		
TEXT BOOKS														
1.		M.P. Jain (2005) <i>Indian Constitutional Law</i> , Wadhwa & Co.												
2.		Rao, Meena (2006), <i>Fundamental Concepts in Law of Contract</i> , 3 rd edn., Professional offset.												
3.		Ramappa (2010), <i>Intellectual Property Rights Law in India</i> , Asia Law House.												
4.		Singh, Avtar (2007), <i>Company Law</i> , Eastern Book Co.												
5.		R.F, Rustamji (1967), <i>Introduction to the Law of Industrial Disputes</i> , Asia Publishing House.												
REFERENCES														
1		Acts: Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act. Maternity Benefit Act – Provident Fund Act – ESI Act – etc.												
2		R.F, Rustamji (1967), <i>Introduction to the Law of Industrial Disputes</i> , Asia Publishing House.												
3		Copyrights Act,1957, Trademarks Act 1999.												
E Resources for Reference														
1.		Intellectual Property rights and Competition Law- https://en.wikipedia.org/wiki/Intellectual_property												
2.		Patent search for engineers and Lawyers - https://www.wipo.int/patents/en/												

COURSE TITLE	INDIAN KNOWLEDGE SYSTEM (IKS)				CREDITS	Non Credit								
COURSE CODE	GGE51015	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2									
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL - 2									
ASSESSMENT SCHEME														
CIA					ESE									
First Periodical Assessment	Second Periodical Assessment	Seminar/Assignment s/Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”	Attendance										
15%	15%	10%	5%	5%										
Course Description	The course provides an appreciation of Indian Knowledge System and its relevance to contemporary society. Indian Knowledge System encompass a wide range of ancient wisdom, including traditional medicine, astrology, yoga, meditation, and more. These systems have been passed down through generations and have played a significant role in shaping India’s history and culture.													
Course Objective	To provide a general introduction to Indian Knowledge System (IKS) and sensitize the students to the contributions made by ancient Indians in the field of Science, Philosophy and related applications and concepts.													
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the salient features of Indian Knowledge System and Vedic Corpus 2. Summarize the concepts of Philosophical systems and wisdom through puranas 3. Describe the Indian Knowledge Framework and Linguistics 4. Brief on ancient strategies to focus on Health, Wellness and Psychology 5. Appreciate Town Planning and Architecture, Governance and Public Administration													
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO -2
CO-1	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-2	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-3	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-4	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-5	-	-	-	-	-	2	2	2	2	1	-	1	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Indian Knowledge Systems and Vedic Corpus (9L)														
India Knowledge Systems – Organization, History and Salient features – synopsis of the four Vedas - Sub-classification of Vedas - Messages in Vedas - Introduction to Vedangas - Prologue on Siksa and Vyakarana - Basics of Nirukta and Chandas - Introduction to Kalpa and Jyotiṣa - Vedic Life: A Distinctive Feature					CO-1 BTL-2									
MODULE 2: Philosophical Systems and Wisdom (9L)														
Philosophical systems - Development of philosophy - Features of philosophy - Sankhya approach of philosophy - Introduction to Yoga - Tenet of Nyaya philosophy - Principles of Vaisesika - Doctrine of Purva Mimamsa Darsana - Thesis of Vedanta and synopsis of Advaita - Philosophy of Visistadvaita - Ideology of Dvaita - Tenets of Jaina - Doctrine of Buddhism - Notions of Carvaka Gateways of ancestral wisdoms - Introduction to Purana - The Puranic repository - Issues of interest in Puranas - Introduction to Itihasas - Key messages in Itihasas - Wisdom through Niti-sastras 8. Wisdom through Subhaṣita					CO-2 BTL-2									
MODULE 3: Knowledge Framework and classifications, Linguistics (9L)														

Indian scheme of knowledge - The knowledge triangle – Prameya - A vaiseshikan approach to physical reality - Dravyas - the constituents of the physical reality – Attributes - the properties of substances and Action - the driver of conjunction and disjunction - Samanya, viseṣa, samavaya - Pramana -the means of valid knowledge - Saṃsaya - ambiguities in existing knowledge - Framework for establishing valid knowledge - Deductive or inductive logic framework - Potential fallacies in the reasoning process - Siddhanta: established tenets in a field of study		CO-3 BTL-2
Linguistics - Aṣṭadhyayi - Phonetics - Word generation - Computational aspects – Mnemonics - Recursive operations - Rule based operations - Sentence formation -Verbs and prefixes - Role of Sanskrit in natural language processing		
MODULE 4: Number Systems, Health Wellness and Psychology (9L)		
Number systems in India - Historical evidence - Salient aspects of Indian Mathematics - Bhuta-Samkhya system - Kaṭapayadi system - Measurements for time, distance, and weight - Pingala and the Binary system		CO-4 BTL-2
Ayurveda: approach to health - Sapta-dhatavaḥ: seven-tissues - Role of Agni in health - Tri-dosas - Ayurveda: definition of health - Psychological aspects of health - Disease management elements - Dinacarya: daily regimen for health & wellness - Importance of sleep - Food intake methods and drugs - Approach to lead a healthy life - Indian approach to psychology - The tri guṇa system & holistic picture of the individual - The Nature of Consciousness - Consciousness studies and issues		
MODULE 5: Town Planning and Architecture, Governance and Public Administration (9L)		
Perspective of Arthasastra on town planning - Vastu-sastra - The science of architecture - Eight limbs of Vaastu - Town planning -Temples in India: marvelous stone architecture for eternity - Temple architecture in India - Iconography		CO-5 BTL-2
Introduction to raja dharma - Arthasastra: a historical perspective - Elements of a kauṭilyan state - The king & the amatya - Janapada & durga - Treasury and the State Economy (Kosa) - Danda 8. Mitra - The Administrative Setup - Relevance of Arthasastra - Public Administration in Epics		
REFERENCE BOOKS		
1	“Introduction to Indian Knowledge System: Concepts and Applications”, Mahadevan B., Bhat Vinayak Rajat, Nagendra Pavana R.N., PHI Learning Private Ltd., 2022.	
MOOC Source		
1.	https://onlinecourses.swayam2.ac.in/imb23_mg55/preview	

MANDATORY COURSES II

COURSE TITLE	TRADITIONAL INDIAN SYSTEMS OF MEDICINE AND THERAPIES			CREDITS	Non Credit Course
COURSE CODE	GGE51021	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2
Version	1.0	Approval Details	36th ACM	LEARNING LEVEL	BTL – 2
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/Assignments/Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”	Attendance	End Semester Exam
15%	15%	10%	5%	5%	50%

Course Description	This comprehensive course aims to provide students with a deep understanding of various aspects of health and well-being while incorporating traditional healing systems like Ayurveda and Siddha medicine. Participants will explore the importance of maintaining physical, mental, emotional, social, and spiritual health for overall well-being.														
Course Objective	1. Understand the importance of maintaining various aspects of health for overall well-being. 2. Explore the unique approach of Ayurveda and its focus on balance and well-being 3. Understand the principles and concepts of Siddha medicine. 4. Understand the importance of a balanced diet in maintaining overall health and preventing diseases. 5. Learn and practice various yogic exercises and postures (Asanas) for physical fitness.														
Course Outcome	1. To identify and prioritize different aspects of health such as physical, mental, social, emotional, etc. 2. To apply Ayurvedic concepts to enhance their well-being and make informed decisions for better health. 3. To explain the underlying philosophy and the use of natural remedies in Siddha medicine for maintaining health and treating various ailments 4. To comprehend the significance of a balanced diet in providing essential nutrients for growth, repair, and overall health. 5. To gain practical experience in performing various yogic exercises and asanas														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1	-	-	-	-	2	1	-	1	-	1	-			
CO-2	2	1	-	-	-	2	1	-	1	-	1	-			
CO-3	2	2	-	-	-	2	1	-	1	-	2	-			
CO-4	1	1	-	2	1	2	2	2	1	-	2	-			
CO-5	3	1	-	3	1	2	2	2	1	-	2	-			
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: Health and Importance of Prevention														9 Hours	
Health: Definition - Importance of maintaining health - More importance on prevention than treatment. Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational / Professional health. Present health status - The life expectancy - present status - mortality rate - dreadful diseases - non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer - diabetes - chronic pulmonary diseases - risk factors - tobacco - alcohol - unhealthy diet - lack of physical activities.														CO 1 BTL 1	
MODULE 2: Ayurveda and Holistic Wellness														9 Hours	

Origin of Ayurveda - Aim and importance of Ayurveda, Philosophy and goals of Ayurveda, Unique Approach of Ayurveda - Ayurveda texts, chakra samhita, Sushruta Samhita, Kashyapa Samhita, Rasatantra, Unique features of Ayurveda - Hygienic principles of Ayurveda (Dhinacharya) - Five elements of Ayurveda Doshas, Gunas, Dhatus, Upahatus, Eight Categories or branches of treatment - Nadisviijnana - Nadis and Chakras, - Characteristics of different prakritis - Ayurveda diet. Ayurveda effects of yogic principles & therapies - Ayurvedic purification practices - Panchakarma - vamanam, virechanam, basti, Anuvasana, Nasya, RaktaMoksana - Abhyanga, Swedanam, Nasayam, Njavarakizhi, Pizhichil.	CO 2 BTL 1
MODULE 3: Siddha Medicine and Naturopathy	9 Hours
History and concepts of Siddha medicine: Principles of Siddha Medicine System, Five Elements Theory, Three Biological Humors, Seven Physical Constituents, Pancha Bhudas, Pancha Koshas, Types of Siddha Medicine, Importance of Karakalpak, Kitchen and herbal medicine, Diet Regulations, Varmam and Thokkanam, Treatment of Siddha Medicine for lifestyle diseases. Concept of Naturopathy, Principles of Naturopathy, Methods of Naturopathy: Diet, Fasting, Treatment by earth, water treatment, Treatment by rays, Massage. Acupuncture, Acupressure, Exercise therapy, Physiotherapy, Music therapy, Color therapy, Magneto Therapy, Reiki.	CO 3 BTL 1
MODULE 4: Role of Diet, Emotional Health, and Stress Management	9 Hours
Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes - arthritis - hypertension - PCOD - infertility - ADHD - sleeplessness - helps to reduce the risk of heart diseases – keeps the teeth and bones strong. Balanced Diet Stress management - Stress definition - Stress in daily life – How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) – Complications of stress mismanagement. Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity- Types and importance – Ways to develop immunity	CO 4 BTL 1
MODULE 5: Yogic Practices for Physical and Mental Well-being	9 Hours
Essentials of Yogic Practices: Emptying the bowels and stomach counter pose, contra-indications, duration, straining, special provisions for women and patients, fitness, posture, side effects, pregnancy women, Group yoga, Individual yoga. Loosening Exercise (Pawana muktasana series 2) and Surya Namaskar (Surya Namaskar: for children 10 Steps, Vivekananda Kendra Model) - Meaning, Definition, Guidelines, Procedure, Breathing technique, Awareness, Contra-indication, and Benefits. Asana: Name, Meaning, Definition, Guidelines, Procedure, Breathing technique, Awareness, Contra-indication, Benefits, Type and Category of each asana. Pranayama and Kriyas: Name, Meaning, Definition, Guidelines, Procedure, Breathing technique, Awareness, Contra-indication, Benefits, Type and Category of each one. Bandhas: Mudras: Meditation: Rajayoga meditation, Trataka Meditation, Soham Meditation, Walking Meditation.	CO 5 BTL 1
Skill Development Activities:	
TEXT BOOKS	

1	Kumar, D. S. (Ed.). (2020). Ayurveda in the New Millennium: Emerging Roles and Future Challenges. CRC Press.
REFERENCE BOOKS	
1	Balakrishnan Acharya(2006) Ayurveda its principles and philophies, Hardwar, Divya Prakashan.
2	AtharaleV.B.(1980) basic principles of Ayurveda, Bombay, Pediatric Clinics.
E-BOOKS / MAGAZINE / ARTICLES	
1	Micozzi, M. S. (2014). <i>Fundamentals of complementary and alternative medicine-E-book</i> . Elsevier Health Sciences.
2	Chaudhry, B. (2019). <i>A handbook of common medicinal plants used in Ayurveda</i> . Kojo Press.
ONLINE RESOURCES	
1.	https://cdn.ayush.gov.in/wp-content/uploads/2021/06/Introduction.pdf
2.	https://www.ism.kerala.gov.in/index.php/downloadss/iec-materials

COURSE TITLE	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA			CREDITS	Non Credit Course
COURSE CODE	GGE51022	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2
Version	1.0	Approval Details	36 TH ACM	LEARNING LEVEL	BTL - 2
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment	Second Periodical Assessment	Seminar/Assignments/Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC”	Attendance	
15%	15%	10%	5%	5%	
Course Description	This course covers the richness of ancient India and their notable contributions in the field of Science and Technology. Details on the living styles of ancient Indians and their application of science and technology in day-to-day life is briefed. Covers the notable contributions of eminent Indian scientists and their contributions to the field of Science and Technology in building a modern India.				
Course Objective	• This course aims to educate upon the notable contributions of ancient indian scientists to the field of Science and Technology • This course details the contributions made by eminent Indian scientists in the various fields of Science and Technology.				

Course Outcome	Upon completion of this course, the students will be able to													
	1. summarize the notable contributions in ancient India in the field of Science and Technology													
	2. explain the different techniques adapted by ancient Indians in the field of Irrigation, Water resources and Ship Building													
	3. appreciate the noteworthy contributions of Indians in the field of Mathematics and Science													
	4. describe the role of Indians in the field of Biotechnology, Space technology and Nanotechnology													
5. report on the prominent scientists of India and present a survey on their noteworthy contributions to the world.														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-2	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-3	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-4	-	-	-	-	-	2	2	2	2	1	-	1	-	-
CO-5	-	-	-	-	-	2	2	2	2	1	-	1	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Contributions made by Ancient Indians to the world of Science and Technology													(9L)	
Ancient India’s contribution to science and technology – Mathematics – Sulvasutra - Ganita– Medicine - Atharva Veda - Charak Samhita - Sushruta Samhita – Chemistry - iron pillar of Mehrauli – Nagarjuna – Ras Ratnakar - Wootz Steel – Smelting of Zinc – Seamless metal globe – Physics – Kanad – Anu – Pancha Bhootas – Vikramaditya – Medicine - Plastic Surgery, Sushruta Samhita – Cataract Surgery, Jabamukhi Salaka – Ayurveda, Charaka Samhita													CO-1 BTL-2	
MODULE 2: Irrigation, water resources and Ship Building													(9L)	
20 traditional water conservation systems of India - 7 Ways Indian Villages Adopted Water Management to Combat Drought - Ship building - Mukti Kalptaru – Sarvamandir – Madhyamandir – Agramandir													CO-2 BTL-2	
MODULE 3: Mathematics and Science													(9L)	
Idea of Zero, Aryabhata – The Decimal System – Numerical Notations and numerals–Fibonacci numbers, Pingala, Virahanka, Gopala and Hemacandra – Binary Numbers - Chhanda Shastra, Chakravala method of Algorithms – Ruler Methods – Heliocentric Theory, Aryabhataiya , quantum physics in Vaisheshika Atomic theory													CO-3 BTL-2	
MODULE 4: Biotechnology, Defence Technology and Nanotechnology													(9L)	
Biotechnology, Genome sequencing initiatives by India, DNA technology regulation Bill – Space Technology, GAGANYAN, Seven Mega Missions by ISRO, Nuclear Technology, India’s three stage Nuclear Programme, India’s Nuclear Policy – Defence Technology, Vikrant, Vikramaditya – Nano Technology, India’s Mission on Nano Science and Technology -													CO-4 BTL-2	
MODULE 5: CONTRIBUTIONS OF INDIANS IN SCIENCE AND TECHNOLOGY													(9L)	
JC Bose, Homi J. Baba, Vikram Sarabhai, Satyendranath Bose, CV Raman, APJ Abdul Kalam													CO-5	

Suggested Activity: To submit a detailed report on Recent contributions by India in the field of Science and Technology		BTL-3
REFERENCE BOOKS		
1	“Science and Technology UPSC Civil Services Exam State Administrative Exams”, Ravi P. Agrahari, McGraw Hill Publications, ISBN-10 935532555X, 7th Edition, 2023	
2	“A Brief History of Science & Technology In India”, Dr. P Lathwal, Indu Book Services Pvt Ltd., ISBN: 9789391377205, First Edition, 2022	
E Resources for Reference		
1.	https://www.thebetterindia.com/63119/ancient-india-science-technology	
2.	https://www.ijedr.org/papers/IJEDR2210086.pdf	
3.	https://www.insightsonindia.com/science-technology/	

COURSE TITLE	POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY				CREDITS	Non Credit Course									
COURSE CODE	GGE51023	COURSE CATEGORY	MC		L-T-P-S	3-0-0-2									
Version	1.0	Approval Details	36th ACM		LEARNING LEVEL	BTL-2									
ASSESSMENT SCHEME															
CIA					ESE										
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc.,	Attendance											
15%	15%	10%	5%	5%			50%								
Course Description	The students shall develop an intuitive understanding of the political and economic thoughts of thinkers from various ages to have an explicit insight into the ideas, values and ethics provided by them.														
Course Objective	• This course aims to equip the students with value building through analyzing the ideas of the thinkers of various ages • This course also equips students with an ability to critically analyse the social, economic and political conditions.														
Course Outcome	Upon completion of this course, the students will be able to 1. Brief on the historic background of economic issues in India. 2. Summarize the theories emerging from western economic and political thought. 3. Describe the emergence of the welfare state and their security implications. 4. Appreciate the significance of Gandhian thoughts and Ambedkar thoughts and the impact on the progress of the nation. 5. Debate on current trends of secularism and their effects on building a nation.														
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	-	-	1	1	-	-	1	-			
CO-2	-	-	-	-	-	1	-	-	1	-	1	-			
CO-3	-	-	-	1	-	1	1	1	-	-	2	-			
CO-4	-	-	-	-	-	1	2	3	-	-	2	-			
CO-5	2	1	1	-	-	2	1	3	2	2	2	1			
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: Historical background of Economic Issues in India							9L								
Impact of colonial rule on Indian Economy; Dadabhai Naoroji- Drain Theory; Post Independence- Nehru and Idea of Socialism, Evolution of Public sector in India.							BTL-1,2								
MODULE 2: Western Economic and Political thought							9L								

Liberalism- Free market, Laissez Faire, Industrial revolution. Communism- Mode of production, theory of Surplus value, Class struggle; Gramsci- Theory of Hegemony	BTL-1,2
MODULE 3: Emergence of Welfare State	9L
Welfare state- Meaning, Womb to Tomb concept and its current state; Security- Shift from traditional security to non-traditional security threats: Human security, Food security and social security	BTL-1,2
MODULE 4: Gandhian and Ambedkar Thought	9L
Gandhi: Swaraj, Decentralization and Ramarajya; Ambedkar: Cultural hegemony.	BTL-1,2
MODULE 5: Current trends	9L
Secularism: Positive and Negative secularism; Affirmative actions, Public distribution system.	BTL-1,2
TEXT BOOKS	
1.	Subrata Mukherjee, Sushila Ramasamy, "A history of Political Thought- Plato to Marx", PHI learning private limited, 2nd edition, 2011
2.	Shafali Jha, "Western Political Thought: From the Ancient Greeks to Modern Times", 2nd Edition by Pearson
REFERENCE BOOKS	
1	Indian Political Thinkers: Modern Political Thought, Atlantic Publishers & Dist, 2000
2	Marx, Karl, 1818-1883. The Communist Manifesto. London; Chicago, Ill. : Pluto Press, 1996.
3	Nehru, Jawaharlal, 1889-1964. The Discovery of India. Garden City, N.Y. : Anchor Books,
4	Gandhi, Mahatma, 1869-1948. The Collected Works of Mahatma Gandhi. New Delhi : Publications Division, Ministry of Information and Broadcasting, Govt. of India,

COURSE TITLE	State, Nation-Building and Politics in India			CREDITS	Non Credit Course
COURSE CODE	EGE51024	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2
Version	1.0	Approval Details	36th ACM	LEARNING LEVEL	BTL – 3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	End Semester Exam
15%	15%	10%	5%	5%	50%
Course Description	After studying the course, the students should be able to gain knowledge of Nation building and the constituents of Indian politics				
Course Objective	1. This course will enlighten the students to learn about the basics of nation building 2. Indian secularism and the salient features of Secular India. 3. To brief on the principles of federalism and its working 4. To understand the administrative framework of Indian Government				
Course Outcome	1. Summarize the basics of nation building with a special reference to Indian constitution. 2. Identify and relate the components that constitute Indian constitution 3. Appraise the salient features of Indian secularism. 4. Classify the principles of Federalism and its relation to central and state autonomy. 5. Illustrate the Indian central administration system and the hierarchy of operations.				

Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	-	-	1	1	-	3	2	3	2	2	2	-			
CO-2	-	-	-	1	-	2	2	2	2	1	2	-			
CO-3	-	-	-	-	-	2	2	2	2	1	2	-			
CO-4	-	-	-	-	-	2	2	2	2	1	2	-			
CO-5	1	1	1	1	-	3	2	3	2	2	2	-			
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: Basic of Nation Building														9 Hours	
Indian government and politics: basics Nation-Building in India: Theoretical, Historical, Cultural perspective, National Movements in India														CO-1 BTL-1,2	
MODULE 2: Indian Constitution														9 Hours	
Making of the Indian Constitution: The Constituent Assembly - Background, Composition, Nature and its working, Ideological Contents: Preamble, fundamental Rights and Directive Principles of State Policy.														CO-2 BTL-2,3	
MODULE 3: Indian Secularism														9 Hours	
Distinctiveness of Indian Secularism, Constitution as an instrument of social change: Constitutional Amendments.														CO-3 BTL-3	
MODULE 4: Federalism														9 Hours	
Federalism and its working: Nature, the Areas of Tension in Centre-State relations, Demands for State Autonomy, Separatist Movements.														CO-4 BTL-3	
MODULE 5: Central Administration														9 Hours	
Executive and Central Administration: President, Prime Minister, and council of ministers, Union Territories: Administration, Critical Appreciation.														CO-5 BTL-3	
TEXT BOOKS															
1.	Indian Government and Politics: Basics / Political Ideologies/ Nation Building, Dr. Jayanta Kumar Dash & Dr. Ratnaprava Barik, Geetanjali Publication 2012														
2.	An Introduction to the Constitution of India. New Delhi: Vikas, 1998. Sikri, S.L. Indian Government and Politics . New Delhi: Kalyani Publishers, 1999 (Reprint).														
REFERENCE BOOKS															

1.	R.N Gilchrist, Principles of Political Science, Bombay: Orient Longmans, Seventh Edition, 1952
2.	Andrew Heywood, Political Theory: An Introduction, United Kingdom: Palgrave Mac Milan, 4 th Edition, 2015.
E-BOOKS / MAGAZINE / ARTICLES	
1.	https://cepr.org/voxeu/columns/nation-building-new-ebook

COURSE TITLE	INDUSTRIAL SAFETY			CREDITS	Non Credit Course
COURSE CODE	GGE51025	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2
Version	01	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment	Second Periodical Assessment	Seminar/Assignments/Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee “DEC””	Attendance	
15%	15%	10%	5%	5%	
Course Description					
Upon completion of the Industrial Safety course, participants will be equipped with the knowledge and skills necessary to foster a safer and healthier workplace, thereby safeguarding workers, assets, and the environment. Whether the students are an industry professional seeking to enhance their safety expertise or a manager responsible for the well-being of their team, this course will empower them to make informed decisions and contribute to a culture of safety excellence within their organization.					
Course Objective					
The objective of this course is to equip students with the knowledge, skills, and mind set necessary to promote a safe and healthy work environment, protect workers and assets, and contribute to the overall success and sustainability of industrial operations. It provides / covers					
1. comprehensive understanding of safety protocols, standards, and practices within industrial settings.					
2. course covers a wide range of safety terminologies used in the industry, enabling students to effectively communicate and engage with safety professionals and colleagues.					
3. delve into the fundamental principles of safety regulations, ensuring compliance with the highest safety standards					
Course Outcome					
Upon completion of this course, the students will be able to					
1. Realize the importance and basic Terminologies of safety.					
2. Enable the students to learn about the Important Statutory Regulations and standards.					
3. Enable students to Conduct and participate the various Safety activities in the industry.					
4. Appreciate about Workplace Exposures and Hazards.					
5. Assess the various Hazards and consequences through various Risk Assessment Techniques.					

CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PS O-2	
CO-1	3	3	2	-	-	2	2	-	-	1	1	2			
CO-2	3	3	2	-	-	2	2	-	-	1	1	2			
CO-3	3	3	2	-	-	2	2	-	-	1	1	2			
CO-4	3	3	2	-	-	2	2	-	-	1	1	2			
CO-5	3	3	2	-	-	2	2	-	-	1	1	2			
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION														(9L)	
Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government, and voluntary agencies in safety. Safety policy - Safety Officer-responsibilities, authority. Safety committee-need, types, advantages. Suggested Reading: Importance of Safety, Health and Environment policies at Workplace														CO-1 BTL-2	
MODULE 2: STANDARDS AND REGULATIONS														(9L)	
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006 Suggested Readings: Industrial Safety Signs: Types of Signs, Regulations, Standards and Best Practices to Promote Safety in the Workplace														CO-2 BTL-3	
MODULE 3: SAFETY ACTIVITIES														(9L)	
Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Suggested Readings: Roles and Responsibilities of Safety Officers and Safety Representatives														CO-3 BTL-3	
MODULE 4: HAZARDS AND RISKS														(9L)	
Hazard and risk, Types of hazards- Mechanical Hazard, Electrical Hazard, Noise hazard and Fire Hazard - Particulate matter- musculoskeletal disorder improper sitting posture and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition. Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants Suggested Readings / Activities: Personal Protective Equipment (PPE), Types of PPE and their appropriate use, PPE selection, maintenance, and training, Assessing PPE effectiveness in hazard control														CO-4 BTL-3	

MODULE 5: HAZARD IDENTIFICATION TECHNIQUES (9L)	
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment Suggested Readings: Guidelines for safe handling, storage, and disposal of hazardous materials in various industries	CO-5 BTL-3
TEXTBOOKS	
1.	R.K. Jain and Prof. Sunil S. Rao, Industrial Safety, Health and Environment management systems, Khanna Publications, 2000.
2.	L. M. Deshmukh, Industrial Safety Management: Hazard Identification and Risk Control, McGraw-Hill Education, 2005.
REFERENCE BOOKS	
1	Frank Lees, 'Lees' Loss Prevention in Process Industries, Butterworth-Heinemann publications, UK, 4th Edition, 2012.
2	John Ridley, John Channing, Safety at Work, 7 th edition, Routledge, 2007.
3	Das Akhil Kumar, Principles of Industrial Safety Management Understanding the Ws of Safety at Work, PHI Learning Pvt Ltd, 2020.
E Resources for Reference	
1.	https://hsseworld.com/wp-content/uploads/2020/08/Industrial-Safety-Management.pdf
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc20_mg43/preview

MANDATORY COURSES III

COURSE TITLE	PRINCIPLES OF MANAGEMENT			CREDITS	Non Credit Course
COURSE CODE	GGE51031	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	To have an in-depth knowledge in basic concepts of management, and also to understand about the functions of Management and their implications in an effective manner.				
Course Objective	1. To make the students to understand the basic concepts of management. 2. To illustrate and evaluate the importance of planning and decision making techniques. 3. To study the different Organizational structures. 4. To understand leadership and the foundation of leadership theories. 5. To know the dimensions of the controlling framework.				
Course Outcome	1. Understand the basic concepts and significance of management in business. 2. Apply and analyze the techniques of planning and apply the Decision-making process in Business organizations. 3. Identify the difference between Centralization and Decentralization and functions of Line and Staff.				

		4. Explain and critically analyse the theories and concepts of leadership and management and their application in organisations. 5. Apply different controlling techniques in different situations													
Prerequisites: Basic understanding of business and business communication.															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PS O-2	PS O-3
CO-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	2	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	-	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO-5	-	-	-	3	-	-	-	-	-	-	-	-	2	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE – 1: INTRODUCTION (9L)															
Definition – Importance – Nature and Scope of Management – Process of Management - Role and functions of Managers - Levels of Management- Managerial Skills- Scientific Management Contributions to Management by different Schools of thought.													CO-1 BTL-2		
MODULE – 2: PLANNING AND DECISION MAKING (9L)															
Nature and purpose of planning - Planning process – Objectives - Management by objective (MBO)- Strategic Planning - Decision Making - Decision Making Process.													CO-2 BTL-3		
MODULE – 3: ORGANIZING (9L)															
Structure, Nature, Types of Organizations, Principles of Organizing; Departmentalization; Delegation; Decentralization of Authority; Span of Control - Line and Staff Functions													CO-3 BTL-4		
MODULE – 4: LEADING (9L)															
Introduction, Characteristics of a Leader, Functions of a Leader; Leadership and Management; Principles of Leadership, Styles of Leaders.													CO-4 BTL-4		
MODULE – 5: CONTROLLING (9L)															
Introduction, Concept of Controlling, Purpose of Controlling; Types of Control; Steps in Controlling; Techniques in Controlling in ethical aspects of management problems.													CO-5 BTL-3		
TEXT BOOKS															
1	Stephen P. Robbins, David A. Decenzo, Fundamentals of Management,11 th edition, Pearson Education, 2020.														
2.	Harold Koontz, O'Donnell and Heinz Weihrich, Essentials of Management. New Delhi, 11th edition, Tata McGraw Hill, 2020.														
REFERENCE BOOKS															
1	L.M.Prasad, Principles and Practice of Management ,20th Edition, Sultan Chand & Sons, 2020.														
2	R.N Gupta,Principles of Management, 2nd Edition, Sultan Chand Ltd. 2005.														
E BOOKS															
1	https://d3bxy9euw4e147.cloudfront.net/oscmsprodcms/media/documents/PrinciplesofManagement-OP.pdf														
2	https://open.lib.umn.edu/principlesmanagement/														
MOOC															

1.	https://onlinecourses.nptel.ac.in/noc21_mg30/
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COURSE TITLE	HUMAN RESOURCE MANAGEMENT			CREDITS	Non Credit Course
COURSE CODE	GGE51032	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2
Version	1.0	Approval Details	36th ACM	LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	To train the students on management of Human Resources by exposing them to theories and practices on HR management
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Course Objective	1. To understand and appreciate the importance and functions of the human resources. 2. To distinguish between Recruitment and Selection. 3. To study the training practices and performance appraisal. 4. To develop an understanding about basics of compensation management. 5. To identify and appreciate the significance of the ethical issues in HR
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Course Outcome	1. Conceptualize, the basic concept of Human Resource Philosophy to changing Environment. 2. Applying the Recruitment and Training methods. 3. Determine the effectiveness with which goals are defined and achieved in team environments to assess the contributions of Managers. 4. Creating and selecting, and apply appropriate techniques, in compensation and quality. 5. Applying ethical principles and commit to professional ethics and responsibilities in labour laws, relations and security
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Prerequisites:

CO, PO AND PSO MAPPING

CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO -1	PSO -2	
CO-1	2	-	2	-	-	2	-	-	-	-	-	1			
CO-2	2	2	-	1	1	2	1	2	-	-	2	2			
CO-3	2	1	2	2	-	2	1	3	-	-	2	3			
CO-4	2	1	-	2	1	2	1	3	-	-	2	3			
CO-5	2	2	-	2	-	2	1	3	-	-	2	3			

1: Weakly related, 2: Moderately related and 3: Strongly related	
MODULE – 1: HUMAN RESOURCE FUNCTION (9L)	
Human Resource Philosophy- Changing environments of HRM-Strategic Human Resource Management-Using HRM to attain competitive advantage-managing migrated workforce-Organization of HR departments- Line and staff functions-Role of Managers. Personnel Management, HRM, HCM-Differences.	CO-1 BTL-2
MODULE – 2: RECRUITMENT & PLACEMENT (9L)	
Man Power Planning and Forecasting-Job analysis: Methods-IT and computerized skill inventory-Job Description-Writing job Specification-HR and the responsive organization. Recruitment: Recruitment Sources-Internal and External-Building employee commitment: Promotion from within-Sources, Developing and Using application forms-E-Recruitment. Employee Testing & Selection: Selection process, basic testing concepts, types of test, work samples & simulation, selection techniques, interview, common interviewing mistakes, Designing & conducting the effective interview, small business applications, computer aided interview.	CO-2 BTL-3
MODULE – 3: TRAINING & DEVELOPMENT (9L)	
Orientation & Training: Orienting the employees, the training process, need analysis, Training techniques, special purpose training, Training via the internet. Developing Managers Management Development-on-the-job Development techniques using HR to build a responsive organization. Key factor for success, Management Development Programs-Objectives and Methods. Performance Appraisal: Methods-problems and solutions- MBO approach- The appraisal interviews- Performance appraisal in practice, Potential appraisal system. Managing Careers: Career planning and development- Managing promotions and transfer. Succession Planning: Family Businesses.	CO-3 BTL-4
MODULE – 4: COMPENSATION & MANAGING QUALITY (9L)	
Establishing Pay Plans: Basics of compensation-factors determining pay rate-Current trends in compensation-Job evaluation-pricing managerial and professional jobs-Computerized job evaluation. Pay for Performance and Financial Incentives: Money and motivation-incentives for operations employees and executives-organization wide incentive plans- Practices in Indian Organizations. Benefits and Services: Statutory benefits-non-statutory (voluntary) benefits-Insurance benefits-retirement benefits and other welfare measures to build employee commitment.	CO-4 BTL-4
MODULE – 5: LABOUR RELATIONS AND EMPLOYEE SECURITY (9L)	
Labour Relations and Employee Security: Industrial Relation-Collective bargaining; Discipline administration; Labour Welfare; Whistle Blowers; Performance Management, HR Accounting, Auditing HR functions, Challenges of HRM function, Absenteeism- Causes of Attrition. Human Resource Audit. Contemporary HR Concepts.	CO-5 BTL-3
TEXT BOOKS	
1	Gary Dessler, “Human Resource Management”, 16 th edition, Prentice-Hall of India.2020
2.	David A. DeCenzo, Stephen P. Robbins , David A. DeCenzo, Stephen P. Robbins, Personnel/Human Resource Management,3 rd edition, Pearson.2022.
REFERENCE BOOKS	

1	John Bernardin H & Joyee E.A Russel, Human Resource Management- An experimental approach, 6 th edition, McGraw-Hill International Edition.,2012.
2	Aswathappa, Human Resource Management, 9 th edition, Tata McGraw Hill, New Delhi, 2021
E BOOKS	
1	https://www.ascdegreecollege.ac.in/wp-content/uploads/2020/12/Human-Resource-Management-by-Pravin-Durai.pdf
2	https://www.yyu.edu.tr/images/files/Turizmde_Insan_Kaynaklari_Gelisimi_Doc_Dr__Zekeriya_NAS(1).pdf
MOOC	
1.	https://www.coursera.org/specializations/human-resource-management

COURSE TITLE	GREEN TECHNOLOGY			CREDITS	Non Credit Course
COURSE CODE	GGE51033	COURSE CATEGORY	MC	L-T-P-S	3-0-0-2
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment	Second Periodical Assessment	Seminar/Assignments/Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC"	Attendance	
15%	15%	10%	5%	5%	
15%	15%	10%	5%	5%	
Course Description	This course aims to equip the students with a basic understanding of concept of sustainable development including different perspectives, consequences of societal resource use and strategies for changing this concept towards a sustainable direction. This course also equips students with an ability to understand the principles of Green Technology and demonstrate how chemical production could be achieved without posing hazard to human health and environment.				
Course Objective	1. To guide the students in understanding the concepts of green technology and its need. 2. To ensure that the students understand the term green oxidation and nanotechnology. 3. To enable the students to explore the Green industrial processes. 4. To enable the student's ability to describe Cleaner Production measures applicable to different industries 5. To guide the students in the application of green chemistry using advanced technologies				
Course	Upon completion of this course, the students will be able to 1. examine the principles of green chemistry and engineering 2. evaluate the approach on green technology towards the new discovery and innovation 3. gain knowledge on Green industrial processes				

Outcome	4. analyze the concept of sustainable development and its importance 5. analyze and select the different principles of green chemistry and sustainable development for various applications.														
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	
CO-1	2	2	3	1	1	1	2	3	1	2	1	3	1	1	
CO-2	-	-	3	2	2	1	2	3	1	2	1	2	1	1	
CO-3	-	-	3	2	2	1	2	3	1	2	1	2	3	2	
CO-4	-	-	3	2	2	1	2	3	1	2	1	1	1	1	
CO-5	-	-	3	2	2	1	2	3	1	2	1	1	3	2	
1: Weakly related, 2: Moderately related and 3: Strongly related															
related															
MODULE 1: INTRODUCTION TO GREEN TECHNOLOGY (9L)															
Principles of green technology, concepts of green chemistry and process intensification.													CO-1 BTL-3		
MODULE 2: GREEN SYNTHESIS AND CATALYSIS (9L)															
Green oxidation and photochemical reactions, Microwave and Ultrasound assisted reactions, Synthesis of Green Reagents, Green solvents, Green nanotechnology and Ionic liquids.													CO-2 BTL-3		
MODULE 3: GREEN INDUSTRIAL PROCESSES (9L)															
Pollution statistics from various industries like polymer, textile, pharmaceutical, dyes, pesticides and wastewater treatment. A greener approach towards all these industries.													CO3 BTL-3		
MODULE 4: GREEN CHEMISTRY & SUSTAINABLE CHEMICAL PROCESSES (9L)															
Resources/Tools for Green Alternatives, Green laws compliance, Examples and impact of green chemistry, Development of Specialized Synthetic Techniques.													CO-4 BTL-3		
MODULE 5: CHALLENGES AND PRACTICAL IMPLEMENTATION (9L)															
Responsibilities and potentials of companies for action. Green Productivity and emerging technologies. Implementation of the practical applications of Green emerging technologies and sustainable development with Case studies.													CO5 BTL-3		
BOOKS															
1	Bishop P. L. McGraw-Hill, Pollution Prevention: Fundamentals and Practice, Boston, 2000.														
2	Anastas P.T. and Warner J.C, Green Chemistry: Theory and Practice, Oxford University Press, 1998.														
3	Marcel Dekker, Introduction to Green Chemistry, A.S. Publisher, Newyork, 2001.														
4	Modak P., Visvanathan C. and Parasnis M, Cleaner Production Audit Environmental System Reviews, Asian Institute of Technology, Bangkok, 1995.														
5	Clark J.H. and Macquarrie D.J, Handbook of Green Chemistry and Technology, Wiley-Blackwell Publishers, 2002														
REFERENCE BOOKS															

1	Ahluwalia, Green Chemistry: Environmentally Benign Reactions, V.K. Ane Books India, New Delhi, India, 2006.
2	Sawyer C.N, McCarty P.L and Parkin G.F, Chemistry for Environmental Engineering and Science, 5th ed. McGraw-Hill Professional, 2003.
3	Lancaster M, Green Chemistry: An Introductory Text, Royal Society of Chemistry, Cambridge, 2002.
E Resources for Reference	
1.	https://link.springer.com/article/10.1007/s11356-022-20024-4
2.	https://iopscience.iop.org/article/10.1088/1755-1315/94/1/012115/pdf
3.	https://iaeme.com/MasterAdmin/Journal_uploads/IJMET/VOLUME_9_ISSUE_3/IJMET_09_03_113.pdf
MOOC	
1.	https://onlinecourses.swayam2.ac.in/aic21_ge16/preview

COURSE TITLE	INDUSTRIAL MANAGEMENT										CREDITS		Non Credit Course		
COURSE CODE	GGE51034				COURSE CATEGORY			MC			L-T-P-S		3-0-0-2		
Version	1.0				Approval Details			37 th ACM			LEARNING LEVEL		BTL-4		
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment				Seminar/ Assignments/ Project			Surprise Test / Quiz			Attendance		ESE		
15%	15%				10%			5%			5%		50%		
Course Description	This course provide brief introduction about the management principles and their functions.														
Course Objective	1. To provide brief introduction about the management principles and their functions. 2. To study the concepts of product design, product layout and PPC functions. 3. To know the material requirement planning and store keeping procedure. 4. To explain the basic principles of TQM. 5. To understand the social responsibilities of engineer and ways to protect our environment														
Course Outcome	1. Interpret given organization structure, and acquire major management skills, familiarize with different leadership styles. 2. Implement product design, and explain different types of plant layout, production modes and PPC functions. 3. Understand the material requirement planning and store keeping procedure and analyze importance of inventory control. 4. Analyze the need of Total Quality management and appreciate the usage of TQM tools in quality control. 5. Incorporate the social responsibilities of engineer and ways to protect our environment														
Prerequisites: Knowledge of English Communication															
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PS O-1	PS O-2	
CO-1	1	-	3	-	-	-	-	-	-	-	-	-	1	-	
CO-2	2	-	-	2	1	-	-	-	-	-	-	-	1	-	

CO-3	-	1	2	-	-	2	-	-	-	-	-	-	2	
CO-4	1	1	-	-	-	-	-	-	-	-	-	-	1	
CO-5	-	-	-	2	-	-	-	-	-	-	-	-	-	
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE – 1: BASICS OF MANAGEMENT														(9L)
Management - Definition – Administration- Definition – Henry-Fayol’s principles of management- Business Organisation -Types- Proprietorship-Partnership- Joint stock-Cooperative Society-Advantages and disadvantages - Organisation-Definition- types of organisation –Line-Functional-Line & staff-advantages and disadvantages- Leadership - Types –Quality of good leader -Motivation - Maslow’s Theory of Motivation -Hierarchy of needs- Communication - Process of Communication – Barriers for effective communication.													CO-1 BTL-2	
MODULE – 2: PRODUCTION MANAGEMENT														(9L)
Project planning -Market survey- Project capacity-selection of site for project- Plant layout- Types of Plant layout- Product design-Material requirement-Production-definition-Job, Batch & Mass production with their advantages and disadvantages-Productivity-definition factors to improve productivity- Production planning and Control (PPC)-definition-Functions of PPC- planning, routing, scheduling, dispatching and Inspection.													CO-2 BTL-3	
MODULE – 3: MATERIALS MANAGEMENT														(9L)
Material management - functions- different methods of purchasing - classification of stores - Functions of store keeper.Inventory Management- Definition - functions of Inventory Control- Advantages of Inventory Control Enterprise resource planning - concept, features and applications - Material Requirement Planning (MRP)-concept, applications -Just in Time (JIT)-concept and benefits-Supply chain management-concept and benefits.													CO-3 BTL-4	
MODULE – 4: TOTAL QUALITY MANAGEMENT														(9L)
Quality–Concept-Quality control- Definition - Factors affecting quality- Different types of inspection - Principles of total quality management- Quality Circles-definition-Function. TQM Tools- Flow charts, Control charts, Histograms, Pareto charts, Cause and effect diagram-5-S- Kaizen, and Six-sigma Quality Certification Systems- ISO 9000 series quality standards, QS14000– ISO 9000, ISO 9001,ISO9002,ISO9003 & ISO 9004- ISO9000 quality certification procedure.													CO-4 BTL-4	
MODULE – 5: SOCIAL ISSUES AND THE ENVIRONMENT														(9L)
Water conservation and rain water harvesting. Climate change: global warming, acid rain, ozone layer depletion-environment and human health-role of information technology in environment and human health.													CO-5 BTL-3	
TEXT BOOKS														
1	T.R.Banga & S C Sharma, Industrial Engineering and Management, 12 th edition,Khanna.Publishers.2008													
2.	Buffa,Modern Production Management,8 th edition, Wiley.2008.													
REFERENCE BOOKS														
1	O. P. Khanna,Industrial Engineering & Management, Dhanpat Rai Publications, 2018.													
2	L.C.Jhamb , Savitri Jhamb , Industrial Management – I , Everest Publishing House,2017													
E BOOKS														
1.	https://ftp.idu.ac.id/wp-content/uploads/ebook/ip/BUKU%20INDUSTRIAL%20ENGINEERING/Industrial%20Engineering%20And%20Management%20by%20Kumar,%20Pravin%20(z-lib.org).pdf													

2.	https://www.booksfree.org/the-principles-of-industrial-management-by-john-c-duncan-pdf-free-download/
MOOC	
1.	https://ufuture.uitm.edu.my/mooc/course_detail.php?course=MEM575

COURSE TITLE	FINTECH AND FINANCING NEW BUSINESS							CREDITS			Non Credit Course				
COURSE CODE	GGE51035			COURSE CATEGORY		MC		L-T-P-S			3-0-0-2				
Version	1.0			Approval Details		36 th ACM		LEARNING LEVEL			BTL-4				
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment			Seminar/ Assignments/ Project		Surprise Test / Quiz		Attendance			ESE				
15%	15%			10%		5%		5%			50%				
Course Description	FinTech, is a combination of traditional financial techniques with technology and innovation. It aims at the application of new technological advancements to the financial industry. At the core, FinTech is used by companies to manage their financial operations in a better way.														
Course Objective	1. To study the overview of Fin Tech. 2. To understand the role of FinTech in financial markets 3. To Identify the key cybersecurity challenges facing FinTech companies. 4. To provide exposure to various banking services and understand various Ancillary Services. 5. To take stock of the technological trends sweeping the financial services sector.														
Course Outcome	1. To identify the key trends driving the growth of FinTech and analyze the challenges and opportunities facing FinTech companies. 2. Analyze the impact of FinTech on the efficiency and liquidity of financial markets. 3. Develop strategies to mitigate cybersecurity risks in FinTech. 4. Use banking services with clear understanding about the various delivery channels. 5. Outline the current global landscape of financial technology Industry.														
Prerequisites: Knowledge of English Communication															
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PS O-1	PS O-2	
CO-1	-	1	-	-	-	-	-	-	-	-	-	-	1	-	
CO-2	2	-	-	2	1	-	-	-	-	-	-	-	1	-	
CO-3	2	1	-	-	-	2	-	-	-	-	-	-	-	1	
CO-4	1	1	2	-	1	-	-	-	-	-	-	-	-	1	
CO-5	-	-	-	2	-	-	-	-	-	-	-	-	-	-	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE – 1: INTRODUCTION TO FIN TECH															
(9L)															

Introduction to FinTech, history of FinTech-key trends driving the growth of FinTech, challenges and opportunities facing FinTech companies- future of FinTech		CO-1 BTL-2
MODULE – 2: FIN TECH AND FINANCIAL MARKETS (9L)		
Primary markets and Secondary market an overview-FinTech and payments, FinTech and lending-FinTech and investments-FinTech and insurance- regulatory landscape for FinTech in financial markets		CO-2 BTL-3
MODULE – 3: FIN TECH AND CYBERSECURITY (9L)		
Cybersecurity threats to FinTech-Cybersecurity best practices for FinTech companies-role of government in regulating FinTech cybersecurity.		CO-3 BTL-4
MODULE – 4: BRANCHLESS BANKING (9L)		
Branchless Banking: Management of alternate delivery channels -Automated Teller Machine (ATM), Phone Banking, Mobile Banking, Card technologies, Internet Banking, Ancillary Services: Interbank Transfer - Electronic Clearing Services (ECS), Electronic Funds Transfer - NEFT, RTGS, SWIFT, Electronic cheques; New payment settlement systems- IM PS -Safe Deposit Lockers; FOREX service; DEMAT and Custodial service.		CO-4 BTL -4
MODULE – 5: TECHNOLOGY DISRUPTIONS ENABLING FINTECH INNOVATION (9L)		
4 G and 5 G networks fueling Fin Tech opportunities, transforming customer experience using Mobile Application and smart phones ,embedded sensors and social media, cloud computing, web 2.0/3.0/4.0,rapid web design, Java Script, Technologies, IoT, Big Data analytics and AI and Block chain.		CO-5 BTL-3
TEXT BOOKS		
1	Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, John Wiley & Sons. 2016	
2.	Parag Y Arjunwadkar, Fintech: The Technology Driving Disruption in the financial service industry CRC press.	
REFERENCE BOOKS		
1	Jonathan Aronson and Peter F. Cowhey, Digital DNA: Disruption and the Challenges for Global Governance, OUP USA, 2017	
2	Rajesh, R., & Sivagnana Siddhi T., “Banking Theory Law & Practice”,Tata Mc Graw Hill.2009.	
E BOOKS		
1.	https://www.amazon.in/Fintech-Founders-Inspiring-Entrepreneurs-Changing-ebook/dp/B08295NZ2T?asin=B08295NZ2T&revisionId=e61ddfa1&format=1&depth=1	
2.	https://www.ebooknetworking.net/ebooks/banking-theory-and-law-practice-by-gurusamy.html	
MOOC		
1.	https://www.edx.org/course/introduction-to-fintech	

MANDATORY COURSE-IV

COURSE	PROFESSIONAL SKILL AND ETHICS									CREDITS			Non Credit	
COURSE CODE	ETP51854			COURSE CATEGORY			MC			L - T – P – S			0-0-3-1	
Version	1.0			Approval Details			41ACM Dt. 13 Jul 24			LEARNING LEVEL			BTL – 3	
CIA											ESE			
First Periodical Assessment	Second Periodical Assessment			Practical Assessments			Observation / lab records as approved by the Department Examination Committee “DEC”			Attendance		Theory		Practical
15%	15%			10%			5%			5%		25%		25%
Course Description	The Grooming and Mock Interview Training course is a focused 10-hour program designed to prepare the students for successful campus placements and professional careers. This course covers essential aspects of personal grooming, professional etiquette, effective communication, resume building, and interview preparation. Through practical exercises, interactive sessions, and real-world scenarios, students will gain the skills and confidence needed to excel in job interviews and professional environments.													
Course Objective	1. To enhance personal grooming and professional etiquette. 2. To improve verbal and non-verbal communication skills. 3. To create customised resumes and cover letters as per job role. 4. To prepare students for various types of interviews. 5. To provide practical experience through mock interviews and group discussions.													
Course Outcome	Upon completion of this course, the students will be able to 1. Exhibit appropriate personal grooming and professional attire suitable for various business environments. 2. Communicate effectively and confidently in verbal and non-verbal interactions, ensuring clarity, articulation, and appropriate tone. 3. Formulate well-structured, targeted resumes and cover letter that highlight relevant skills, achievements, and experiences. 4. Prepare for different types of interviews (HR and Technical), knowing what each assesses. 5. Engage confidently in mock interviews, receiving and incorporating feedback to improve performance.													
Prerequisites: Plus Two English-Intermediate Level														
CO, PO AND PSO MAPPING														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	1	2	-	3	1	2
CO2	-	-	-	-	-	-	-	2	2	2	-	3	1	1
CO3	-	-	-	-	-	-	-	2	2	2	-	3	2	1
CO4	-	-	-	-	-	-	-	-	1	2	2	3	1	1

CO5	-	-	-	-	-	-	-	-	2	2	2	3	1	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
Module 1 : BUSINESS ETHICS AND ETIQUETTE														(9P)
Importance of personal grooming-Dressing for success: Business formal and business casual attire- Personal hygiene and grooming tips- Makeup and accessories for a professional look- Introduction to professional behavior-Business etiquettes: Do's and don'ts-Practice for professional dressing, Dining Etiquettes														CO-1 BTL-2
Module 2 : TAILORING AND CUSTOMIZING RESUME TO MEET JOB ROLE INCLUDING COVER LETTER														(9P)
Key components of a professional resume- Tailoring your resume for different job profiles- Use of Action verbs in Resume-Resume do's and don'ts- Reviewing and refining student resumes as per job description- Customizing cover letters for specific roles, Preparation of Checklist and Portfolio, Researching for the company and gaining details of the job description														CO-2 BTL-3
Module 3: VERBAL AND NON-VERBAL PRESENTATION IN THE INTERVIEW														(9P)
Effective speaking skills-Articulation and clarity-Tone and pitch control- Introducing oneself in a professional setting- Making first impression- Non-Verbal Communication: Importance of body language-Eye contact, facial expressions, and gestures- Posture and handshake- Magics of smile in interview-Role-playing exercises to enhance non-verbal cues- Time management in interviews														CO-3 BTL-3
Module 4: INTERVIEW PREPARATION TECHNIQUES														(9P)
Overview of different types of interviews: HR and Technical-Understanding what each type of interview assesses- Discussing frequently asked interview questions- STAR method for answering behavioural questions (Situation, Task, Action, Result)- Practice for answering common questions in pairs, Removing Fear, nervousness and anxiety using relaxation method and breathing techniques														CO-4 BTL-3
Module 5 : MOCK INTERVIEWS AS PER JOB ROLE AND FEEDBACK														(9P)
Simulated one-on-one interviews as per job description with feedback-Role-playing in different interview scenarios (HR, Technical)- Time management in responses-Feedback to Each Student regarding merits and scopes for improvement, Advanced strategies for handling difficult interview questions, Negotiation skills and salary discussions, Interaction with Alumni Ambassadors-Full length Panel Interview Follow-Up Emails and Letters- Maintaining Professional Connections and networking														CO-5 BTL-3
TEXT BOOK														
1	Collins, Allan (2016). HR Interview Secrets: How To Ace Your Next Human Resources Interview, Dazzle Your Interviewers & LAND THE JOB YOU WANT! USA: Success in hr.													

HONORS COURSES OFFERED BY DEPARTMENT OF AUTOMOBILE ENGINEERING

LIST OF COURSES UNDER THE HONORS IN MOTORSPORT ENGINEERING:

SEMESTER - V									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1.	HN	EAT51900	Race Car Anatomy	3	0	0	3	1	3
SEMESTER - VI									
2.	HN	EAT51901	Motorsport Vehicle System Design	3	0	0	3	1	3
SEMESTER - VII									

3.	HN	EAT51902	Aerodynamics for Race Cars	3	0	0	3	1	3
4.	HN	EAT51903	Racetrack and Data Management	3	0	0	3	1	3
Total Credits							12		

COURSES UNDER THE HONORS IN MOTORSPORT ENGINEERING:

Syllabus

V SEMESTER:

COURSE TITLE	RACE CAR ANATOMY								CREDITS			3		
COURSE CODE	EAT51900		COURSE CATEGORY				HN		L-T-P-S			3-0-0-1		
Version	1.0		Approval Details				36th ACM		LEARNING LEVEL			BTL-3		
ASSESSMENT SCHEME														
First Periodical Assessment	Second Periodical Assessment		Seminar/ Assignments/ Project				Surprise Test / Quiz		Attendance			ESE		
15%	15%		10%				5%		5%			50%		
Course Description	This course gives historical development of motorsport and competition vehicle evolution.													
Course Objectives	1. To discuss on historical development of motorsport and competition vehicle evolution. 2. To identify the systems and components of a racing car 3. To illustrate sporting and technical regulations and techniques used in racing car design and manufacture 4. To examine the interaction between various design parameters of a racing car 5. To demonstrate key features of various software packages related to Motorsports.													
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on historical development of motorsport and competition vehicle evolution. 2. Identify the systems and components of a racing car 3. Illustrate sporting and technical regulations and techniques used in racing car design and manufacture 4. Examine the interaction between various design parameters of a racing car 5. Demonstrate key features of various software packages related to Motorsports.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	1	1	1	2	-	-	-	1	-	1	-	1	1	2
CO-2	2	1	2	1	1	2	1	-	2	1	1	2	2	1
CO-3	1	2	1	2	-	-	-	1	-	1	-	1	1	2
CO-4	2	1	1	2	-	2	1	-	2	2	1	2	2	1
CO-5	1	1	1	2	1	-	-	1	-	1	-	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: HISTORY OF MOTORSPORT AND COMPETITION VEHICLE DEVELOPMENT													(9L)	
The history of motorsport engineering-Review of motorsport engineering-Pioneers of Motorsport engineering -Motorsport technology evolution review - A brief look at all the events students can take part to develop their skills. Suggested Reading: Secrecy in Motorsport engineering													CO-1 BTL-2	
MODULE 2: COMPONENTS OF A RACING CAR													(9L)	

Chassis types - Suspension systems - Springs and dampers - Steering systems - Braking systems – Engines - Fuel systems - Exhaust systems - Transmission systems - Cooling systems - Effects of aerodynamics - Data logging, sensors, and engine management. Suggested Reading: Aero kits used in race cars	CO-2 BTL-2
MODULE 3: SPORTING AND TECHNICAL REGULATIONS (9L)	
All about the most important book for a motorsport engineer – the rule book - About - the world governing bodies of the sport - Why the rule book keeps changing - How to interpret the rule book- Rules for car races - Rules for bikes races. Motorsport Engineer Race Driver / Rider - Test Driver / Rider - Design engineer - Race technician -Aerodynamics Engineer - Race official / steward.	CO-3 BTL-3
MODULE 4: DESIGN OF COMPETITION VEHICLES (9L)	
Identify important design objectives for a successful racing car - Compute loads on a car during operating conditions like Acceleration, Braking, Cornering. Design objectives of a racing car structure - Different types of structures like: space-frame, monocoque and stressed skin - Loads on the chassis structure - Analysis techniques for the frame - Passive safety structures Suggested Reading: Study how these loads influence the aerodynamic forces acting on the car.	CO-4 BTL-2
MODULE 5: INTRODUCTION TO SOFTWARE PACKAGES RELATED TO MOTORSPORT ENGINEERING (9L)	
ANSYS, OptimumLap, Chassis Sim, Data logger, ADAMS, Matlab & Race Technology Analysis software. Suggested Reading: Race track data reading in excel.	CO-5 BTL-4
TEXT BOOKS	
1.	Milliken and Milliken, “Race Car Vehicle Dynamics”, Premier Series books, 2015.
2.	Terry Jackson, “Anatomy of Speed: Inside the World's Great Race Cars”.
REFERENCE BOOKS	
1.	Forbes Aird, Race Car Chassis: Design and Construction [Powerpro]
2.	Carroll Smith, Engineer to Win: The Essential Guide to Racing Car Materials Technology or How to Build Winners Which Don't Break.

VI SEMESTER:

COURSE TITLE	MOTORSPORT VEHICLE SYSTEM DESIGN			CREDITS	3
COURSE CODE	EAT51901	COURSE CATEGORY	HN	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	33 rd ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course provides motorsport vehicle design procedure and calculation.				

Course Objectives	1. To discuss engine performance and engine simulation techniques 2. To test the physical processes at work during the preparation of the fuel & air mixture 3. To evaluate the matching of engine, transmission and induced vibration for motorsport applications 4. To demonstrate the race dynamics and control systems. 5. To examine hybridization and electrification of motorsport powertrains													
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss engine performance and engine simulation techniques 2. Test the physical processes at work during the preparation of the fuel & air mixture 3. Evaluate the matching of engine, transmission and induced vibration for motorsport applications 4. Demonstrate the race dynamics and control systems. 5. Analyse hybridization and electrification of motorsport powertrains													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	1	2	-	1	-	1	-	1	-	1	1	2
CO-2	2	2	2	1	1	2	1	-	2	1	1	2	2	1
CO-3	1	2	1	2	-	-	-	1	-	1	-	1	1	2
CO-4	2	1	1	2	-	2	1	-	2	2	1	2	2	1
CO-5	1	1	1	2	1	-	-	1	-	1	-	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: ENGINE POWER AND CHARACTERISTICS (9L)														
Gasoline engine performance characteristics: performance indices - Idealized thermodynamic cycles and the limits to ideal behavior - Maximizing power output using high engine speeds: thermo-fluid implications. Practice: TSi and GDI in motorsports													CO-1 BTL-2	
MODULE 2: AIR FUEL AND COMBUSTION (9L)														
Maximizing 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. Practice: Ramjet injection and pilot injection in motorsports engines													CO-2 BTL-2	
MODULE 3: TRANSMISSION AND INDUCED VIBRATION (9L)														
The matching of engine, transmission and vehicle - The design of high-performance vehicle transmission systems - Limit behavior and design aspects - differentials and brake balancing - Simulation tools and model building - Vibration behavior of car and wheels; springs; dampers; track roughness. Practice: The use of electro-hydraulic shaker rigs for setup.													CO-3 BTL-3	
MODULE 4: RACE DYNAMICS AND CONTROL (9L)														

Minimum time optimization - Tyre shear force development, measurement and characterization - Suspension geometry description and analysis – important properties - Steady turning equilibrium states; suspension/chassis interactions; roll angles, load transfers, jacking - Yaw/sideslip handling dynamics; steady turn responses, understeer and oversteer. Practice: Analysis of stability and controllability of vehicles		CO-4 BTL-4
MODULE 5: HYBRID AND ELECTRIC DRIVELINE (9L)		
Layout of an electric vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system - Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits. Practice: series and parallel hybrid electric drive train design using MATLAB.		CO-5 BTL-4
TEXT BOOKS		
1.	Donald L Anglin and William H Crouse, Automotive mechanics, McGraw Hill Education; 10 th Edition.	
2.	Herald Naunheimer, Bernd Bertsche, Joachim Ryborz and Wolfgang Novak, Automotive transmissions: Fundamentals, selection, Design and application, Springer science & Business media.	
REFERENCE BOOKS		
1.	Julian Happian, An Introduction to Modern Vehicle Design, Publisher: SAE International, 2014.	
2.	John Fenton, Handbook of Vehicle Design Analysis, Published by Society of Automotive Engineers Inc, 2016	
PRACTICE:		
1. Simulate the vehicle performance characteristics of the designed vehicle using OptimumLap Software. 2. Compare the old Vs new design as per the results obtained from Optimum Lap software and submit report.		

VII SEMESTER:

COURSE TITLE	AERODYNAMICS FOR RACE CARS			CREDITS	3
COURSE CODE	EAT51902	COURSE CATEGORY	HN	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	33 rd ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments / Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course provides race car aerodynamics practice and its limitations, and some appreciation of likely new developments.				
Course Objectives	1. To examine vehicle aerodynamics and wind tunnel technology 2. To develop current Race Car Aerodynamics practice 3. To apply engineering techniques taking account of a range of commercial and industrial constraints using CFD 4. To discuss on different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader. 5. To demonstrate advanced level knowledge and understanding of a wide range of engineering materials and components.				

Course Outcomes	Upon completion of this course, the students will be able to													
	1. Examine vehicle aerodynamics and wind tunnel technology													
	2. Develop current Race Car Aerodynamics practice													
	3. Apply engineering techniques taking account of a range of commercial and industrial constraints using CFD													
	4. Discuss on different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader.													
	5. Demonstrate advanced level knowledge and understanding of a wide range of engineering materials and components.													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	P O - 1	PO -2	PO -3	PO -4	PO- 5	PO- 6	PO -7	PO -8	PO -9	P O - 10	PO -11	PO -12	PSO -1	PSO -2
CO-1	2	1	1	2	-	1	-	1	-	1	-	1	1	2
CO-2	2	2	2	1	1	2	1	-	2	1	1	2	2	1
CO-3	1	2	1	2	-	-	-	1	-	1	-	1	1	2
CO-4	2	1	1	2	-	2	1	-	2	2	1	2	2	1
CO-5	1	1	1	2	1	-	-	1	-	1	-	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: VEHICLE AERODYNAMICS (9L)														
Vehicle resistances and types - Various types of forces and moments - Various body optimization techniques for minimum drag - Principle of wind tunnel technology - Flow visualization techniques. Practice: Tests with scale models.													CO-1 BTL-3	
MODULE 2: RACE CAR AERODYNAMICS AND RECENT DEVELOPMENTS (9L)														
Basic flow concepts and governing equations - A review of the fundamental aerodynamic characteristics of streamlined and bluff bodies - The application of aerodynamic design principles to motorsport wings and diffusers. Suggested Reading: Mechanisms for controlling aerodynamic lift and drag generation.													CO-2 BTL-3	
MODULE 3: APPLICATION OF CFD IN RACE CARS (9L)														
Introduction to CFD - Fluid dynamics - governing equations - Grid generation, techniques and application - Solution strategies Practice: Numerical modelling of fluid flow around vehicle body													CO-3 BTL-4	
MODULE 4: AERODYNAMIC PERFORMANCE ENHANCEMENTS (9L)														
An introduction to aerodynamic issues related to cooling and ventilation flows - An introduction to wheel aerodynamics - An overview of open-wheel, sports car and touring car aerodynamics. Practice: Experimental methods for motorsport aerodynamics and use of a moving ground wind tunnel for race car.													CO-4 BTL-2	
MODULE 5: AERODYNAMIC MATERIALS AND COMPONENTS (9L)														
Materials forms, performance and selection - Composites application of in Motorsport industry through case studies - Composite structures design, analyses and optimization techniques - Design of safety structures. Suggested Reading: Modern Manufacturing technology and joining techniques- making GRPF sheets													CO-5 BTL-2	
TEXT BOOKS														
1.	W.H. Hucho, 'Aerodynamics of Road Vehicles', Butterworth and Co., 2014.													
2.	Joseph Katz, Race Car Aerodynamics, Butterworth and Co., 2015.													
REFERENCE BOOKS														
1.	E.L.Houghton & P.L.Carpenter, "Aerodynamics for Engineering students", Butterworth Heinman and Co., 2013.													
2.	Milliken and Milliken, "Race Car Vehicle Dynamics", Butterworth and Co., 2015.													

COURSE TITLE		Race Track and Data Management								CREDITS			3	
COURSE CODE		EAT51903		COURSE CATEGORY			HN			L-T-P-S			3-0-0-1	
Version		1.0		Approval Details			33 rd ACM			LEARNING LEVEL			BTL-3	
ASSESSMENT SCHEME														
First Periodical Assessment		Second Periodical Assessment		Seminar/ Assignments/ Project			Surprise Test / Quiz			Attendance			ESE	
15%		15%		10%			5%			5%			50%	
Course Description		This course gives evolution of motorsports, track design and its specialties, track data and analyze the performance peaks												
Course Objectives		1. To discuss the evolution of motorsports 2. To develop the track design and its specialties 3. To design the racetrack in real time 4. To develop track data and analyze the performance peaks 5. To assess the challenges facing the motorsport sector and distinguish the motorsport environment and the influences on its development.												
Course Outcomes		Upon completion of this course, the students will be able to 1. Discuss the evolution of motorsports 2. Develop the track design and its specialties 3. Design the racetrack in real time 4. Develop track data and analyze the performance peaks 5. Assess the challenges facing the motorsport sector and distinguish the motorsport environment and the influences on its development.												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PS O-2
CO-1	2	1	1	2	-	1	-	1	-	1	-	1	1	2
CO-2	2	2	2	1	1	2	1	-	1	2	1	2	2	1
CO-3	1	2	1	2	-	1	-	1	-	1	-	1	1	2
CO-4	2	1	1	2	-	2	1	-	2	2	1	2	2	1
CO-5	1	1	1	2	1	-	1	1	-	1	-	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: INTRODUCTION TO MOTORSPORTS													(9L)	
History of motorsport and competition vehicle development - Competition vehicle categories -Sporting and technical regulations - Design of competition vehicles. Practice: Various competition conducted for car and bikes around the world.													CO-1 BTL-3	
MODULE 2: INSIDE RACING TECHNOLOGY													(9L)	
Understanding race car – Understanding racetrack – Apex line – Racing line – Fast lane – Tip-Toe – Downshift – Straight line - Dragging – Throttle – Pitlane. Practice: Discussions of racing technical topics.													CO-2 BTL-3	
MODULE 3: TRACK DAY IN MMRT													(9L)	
Understanding the MMRT Race Track – Simulator Training – POLO GTI car driving training in MMRT. Practice: Discussion about the MMRT design and its specialties													CO-3 BTL-3	
MODULE 4: TRACK DATA LOGGER													(9L)	
Identifying the Raw track Data – Analyzing the Data in Excel – Peak performance graphs – Tuning with data logger – Track simulation – Lap time logger -RPM vs Power graph logger. Practice: Analyze the track data set with MATLAB.													CO-4 BTL-3	
MODULE 5: BUSINESS IN MOTORSPORTS													(9L)	
The business environment in general - The business context for motorsport organizations - Managing motorsport businesses strategically - Creating and sustaining competitive advantage													CO-5 BTL-2	

in motorsport - Commercial aspects of motorsport management - Managing technical knowledge and expertise in motorsport - Technology transfer and opportunities for diversification.		
Practice: Project management and motorsport		
TEXT BOOKS		
1.	Ayrton Senna, “Ayrton Senna's Principles of Race Driving”	
2.	Buddy Fey, Data Power: Using Racecar Data Acquisition: A Practical Guide to: Selection and Setup Data Interpretation Trackside Operation.	
REFERENCE BOOKS		
1.	Winning: A Race Drivers Handbook by George A. Anderson	
2.	Drive to Win: The Essential Guide to Race Driving by Carroll Smith	
3.	Competition Car Data Logging: A Practical Handbook by Simon McBeath	
PRACTICES TARGETS		
Track Day in MMRT on the race weekend.		
• Perform race preparation document for the saloon and open wheel category races • Assess the race weekend strategies executed by the Teams for MMRT Track • Submit the consolidated report for the track day including observations of the different racing teams.		

LIST OF COURSES UNDER THE HONOURS IN AUTOTRONICS:

SEMESTER - V									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1.	HN	EAT51904	Perception System for Autonomous Car	3	0	0	3	0	3
SEMESTER - VI									
2.	HN	EAT51905	Intelligent Transport system and V2V technology	3	0	0	3	0	3
SEMESTER - VII									
3.	HN	EAT51906	Pose Estimation for Autonomous Car	3	0	0	3	0	3
4.	HN	EAT51907	State Estimation and Vehicle control for Autonomous Car	3	0	0	3	0	3
Total Credits							12		

V SEMESTER:

COURSE TITLE	PERCEPTION SYSTEM FOR AUTONOMOUS CAR			CREDITS	3
COURSE CODE	EAT51904	COURSE CATEGORY	HN	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	36th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	This course provides various Sensor technologies and techniques used in autonomous car.													
Course Objectives	1. To discuss the concept of autonomous car and its architecture 2. To demonstrate the concept of an environment perception system 3. To apply the positioning system 4. To develop state estimation and localization 5. To design the concept of Sensor Fusion and system integration techniques													
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss the concept of autonomous car and its architecture 2. Demonstrate the concept of an environment perception system 3. Apply the positioning system 4. Develop state estimation and localization 5. Design the concept of Sensor Fusion and system integration techniques													
Prerequisites:														
CO, PO AND PSO MAPPING														
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS O-1	PS O-2
CO-1	3	2	1	3	-	-	-	1	-	1	1	1	1	2
CO-2	2	3	2	2	1	-	2	-	-	2	1	2	2	1
CO-3	1	2	1	2	-	-	-	1	-	1	1	1	1	2
CO-4	2	2	1	2	-	2	1	-	2	2	1	2	2	1
CO-5	2	1	1	2	1	-	-	1	-	1	1	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Introduction to Autonomous Cars and its Architecture														(9L)
Taxonomy of Driving -Requirements for Perception -Driving Decisions and Actions -Sensors and Computing Hardware -Hardware Configuration Design -Software Architecture - Environment Representation -Safety Frameworks for Self-Driving. Case Studies on Google car – Uber car Practice on MATLAB Automated Driving Tool Box – Introduction													CO-1 BTL-3	
MODULE 2: Environment Perception System														(9L)
Position and orientation Estimation - LIDAR Sensor -LIDAR Sensor Models and Point Clouds - Pose Estimation from LIDAR Data -RADAR Sensor - Sensor Models - Pose Estimation from RADAR Data -Camera and computer vision - Pose Estimation methods. Practice on MATLAB Automated Driving Tool Box using LIDAR/ RADAR/ Camera Sensor													CO-2 BTL-3	
MODULE 3: Position Estimation Systems and advanced mechatronics systems														(9L)
GNSS/INS Sensing for Pose (position and orientation) Estimation -Ultrasonic Sensor -IR Sensor - IMUs -Night Vision Technology – advanced mechatronics system -Intelligent mechatronics - intelligent computation -ECU Architecture - Sensor hardware architecture. Practice on MATLAB Automated Driving Tool Box – Design techniques													CO-3 BTL-3	
MODULE 4: State Estimation, Localization and Vehicle control														(9L)
State Estimation and Optimizing - The Challenges of State Estimation -Path Planning, Autonomy and Decision Making - Vehicle control and Actuation - Longitudinal & Lateral Vehicle Modeling and control Practice on MATLAB Automated Driving Tool Box – Vehicle control logic													CO-4 BTL-3	
MODULE 5: Sensors Fusion and Integration of Sensor Data														(9L)
Fusion Methods in Perception Systems -Fusion Methods in Positioning Systems -Multi sensor Fusion for State Estimation -Sensor Calibration- use of sensor fusion data - Integration of Sensor Data to On-Board Control Systems - Integration Techniques. Practice on MATLAB Automated Driving Tool Box – Testing techniques													CO-5 BTL-3	
TEXT BOOKS														
1.	Jacob Fraden, Handbook of Modern Sensors- Springer, 2nd Edition, 2010.													
2.	Simon M. Sze Wiley, Semiconductor Sensors, Interscience, 3 edition, 2012.													
REFERENCE														
1.	Google car –waymo - Uber car – Toyota cars – Volvo cars													

VI SEMESTER:

COURSE TITLE		INTELLIGENT TRANSPORT SYSTEM AND V2V TECHNOLOGY								CREDITS			3		
COURSE CODE		EAT51905		COURSE CATEGORY			HN			L-T-P-S			3-0-0-1		
Version		1.0		Approval Details			36th ACM			LEARNING LEVEL			BTL-3		
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment			Seminar/ Assignments/ Project			Surprise Test / Quiz			Attendance			ESE	
15%		15%			10%			5%			5%			50%	
Course Description		This course provides knowledge on intelligent transport system and vehicle to vehicle technology													
Course Objectives		1. To discuss on Intelligent Transportation Systems (ITS) 2. To demonstrate telecommunications in ITS 3. To design ITS functional areas 4. To describe ITS user needs and services 5. To develop Vehicle-to-Vehicle (V2V) Communications													
Course Outcomes		Upon completion of this course, the students will be able to 1. Discuss on Intelligent Transportation Systems (ITS) 2. Demonstrate telecommunications in ITS 3. Design ITS functional areas 4. Describe ITS user needs and services 5. Develop Vehicle-to-Vehicle (V2V) Communications													
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO -5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PS O-1	PS O-2	
CO-1	2	2	1	3	-	1	-	1	-	1	1	1	1	2	
CO-2	2	3	2	2	1	-	1	1	-	2	1	2	2	1	
CO-3	1	2	1	2	-	-	-	1	-	1	1	1	1	2	
CO-4	2	2	1	2	-	2	1	2	2	2	1	2	2	1	
CO-5	2	1	1	2	1	-	-	1	-	1	1	1	1	2	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: Introduction to Intelligent Transportation Systems (ITS) (9L)															
Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.													CO-1 BTL-2		
MODULE 2: Telecommunications in ITS (9L)															
Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centers (TMC). Vehicle – Road side communication – Vehicle Positioning System.													CO-2 BTL-2		
MODULE 3: ITS functional areas (9L)															
ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).													CO-3 BTL-3		
MODULE 4: ITS User Needs and Services (9L)															
ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management. Automated Highway Systems -													CO-4 BTL-2		

Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.		
MODULE 5: Vehicle-to-Vehicle (V2V) Communications		(9L)
Dedicated short range communications (DSRC) –V2V vs V2I vs V2X vs V2N vs V2P -Importance of ongoing 5G development –GPS receivers and V2V –Laser Illuminated Detection and Ranging (LiDAR) –Inertial navigation systems –Characteristics of a wireless mesh network –V2V and Cybersecurity.		CO-5 BTL-2
TEXT BOOKS		
1.	Kan Paul Chen, John Miles, ITS Handbook: Recommendations for World Road Association (PIARC)	
2.	Sussman, J. M., Perspective on ITS, Artech House Publishers, 2015.	
3.	Dimitrakopoulos, George: Current Technologies in Vehicular Communication, Springer, 2017.	
REFERENCE		
1.	National ITS Architecture Documentation, US Department of Transportation, 2017.	

VII SEMESTER

COURSE TITLE		POSE ESTIMATION FOR AUTONOMOUS CAR								CREDITS			3	
COURSE CODE		EAT51906			COURSE CATEGORY			HN		L-T-P-S			3-0-0-1	
Version		1.0			Approval Details			36th ACM		LEARNING LEVEL			BTL-3	
ASSESSMENT SCHEME														
First Periodical Assessment		Second Periodical Assessment			Seminar/ Assignments/ Project			Surprise Test / Quiz		Attendance			ESE	
15%		15%			10%			5%		5%			50%	
Course Description		This course provides knowledge on Position and orientation Estimation, Pose Estimation from LIDAR Data, RADAR Data, GNSS/INS and Camera and computer vision												
Course Objectives		1. To develop the concept of Position and orientation Estimation 2. To utilize the Pose Estimation from LIDAR Data 3. To construct the Pose Estimation from RADAR Data 4. To develop Pose Estimation from GNSS/INS 5. To demonstrate the concept of Camera and computer vision												
Course Outcomes		Upon completion of this course, the students will be able to 1. Develop the concept of Position and orientation Estimation 2. Utilize the Pose Estimation from LIDAR Data 3. Construct the Pose Estimation from RADAR Data 4. Develop Pose Estimation from GNSS/INS 5. Demonstrate the concept of Camera and computer vision												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	2	2	1	3	-	1	-	1	-	1	1	1	1	2
CO-2	2	3	2	2	1	-	1	1	-	2	1	2	2	1

CO-3	1	2	1	2	-	-		1	-	1	1	1	1	2
CO-4	2	2	1	2	-	2	1	2	2	2	1	2	2	1
CO-5	2	1	1	2	1	-	-	1	-	1	1	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: Position and orientation Estimation													(9L)	
Introduction to Position and orientation Estimation – Methodology – Compute Jacobian method – compute M Matrix method – Gauss Newton method – angle from quaternion – Gradient descent – kalman Filter - error-state extended Kalman filter.													CO-1 BTL-2	
MODULE 2: LIDAR Sensor Models and Point Clouds													(9L)	
LIDAR Sensor -Pose (position and orientation) Estimation from LIDAR Data - Point Clouds – 3D & 2D Point Clouds - inverse and forward sensor models for a basic scanning LIDAR - iterative closest point (ICP) algorithm - problem of motion distortion can affect LIDAR scans acquired from a moving vehicle. <i>Practice- Design perception system using LIDAR Sensor in MATLAB Automated Driving Tool Box</i>													CO-2 BTL-3	
MODULE 3: Pose Estimation from RADAR Data													(9L)	
RADAR Sensor - Sensor Models - Pose Estimation from RADAR Data – localization – path planning – decision making <i>Practice- Design perception system using RADAR Sensor in MATLAB Automated Driving Tool Box</i>													CO-3 BTL-3	
MODULE 4: IMU for Pose Estimation													(9L)	
IMU- Sensor Models - Pose Estimation from IMU - coordinate acceleration - fundamental equation of inertial navigation - gyroscope and accelerometer measurement models in the context of navigation <i>Practice- Design perception system using IMU Sensor in MATLAB Automated Driving Tool Box</i>													CO-4 BTL-3	
MODULE 5: Camera and computer vision - Pose Estimation methods													(9L)	
Computer Vision, Estimation, Random Sample Consensus (Ransac), Geometry - pinhole camera model - intrinsic and extrinsic camera calibration - tracking, and semantic segmentation for drivable surface estimation <i>Practice- Design perception system using Camera Sensor in MATLAB Automated Driving Tool Box</i>													CO-5 BTL-3	
TEXT BOOKS														
1.	Paul F. McManamon, LiDAR Technologies and Systems, SPIE Publications, 2019													
2.	Changzhan Gu, Short-Range Micro-Motion Sensing with Radar Technology, IET, 2019.													
3.	Himanshu Prakash Jain, Anbumani Subramanian “Real-Time Upper-Body Human Pose Estimation Using a Depth Camera” Research Article.													
REFERENCE BOOKS														
1.	Christian Wöhler “3D Computer Vision: Efficient Methods and Applications X. media publishing, 2012.													
2.	Peter J.G. Teunissen, Oliver Montenbruck, Springer Handbook of Global Navigation Satellite Systems, 2017.													

COURSE TITLE		STATE ESTIMATION AND VEHICLE CONTROL FOR AUTONOMOUS CAR								CREDITS			3	
COURSE CODE		EAT51907			COURSE CATEGORY			HN		L-T-P-S			3-0-0-1	
Version		1.0			Approval Details			36th ACM		LEARNING LEVEL			BTL-3	
ASSESSMENT SCHEME														
First Periodical Assessment		Second Periodical Assessment			Seminar/ Assignments/ Project			Surprise Test / Quiz		Attendance			ESE	
15%		15%			10%			5%		5%			50%	
Course Description		This course provides knowledge on concept of State Estimation and Optimizing, Path Planning, Autonomy and Decision Making, Vehicle control and Actuation, Longitudinal & Lateral Vehicle Modeling.												
Course Objectives		1. To apply the concept of State Estimation and Optimizing 2. To design the concept of Path Planning 3. To develop the concept of Autonomy and Decision Making 4. To demonstrate the concept of Vehicle control and Actuation 5. To construct the concept of Longitudinal & Lateral Vehicle Modeling												
Course Outcomes		Upon completion of this course, the students will be able to 1. Apply the concept of State Estimation and Optimizing 2. Design the concept of Path Planning 3. Develop the concept of Autonomy and Decision Making 4. Demonstrate the concept of Vehicle control and Actuation 5. Construct the concept of Longitudinal & Lateral Vehicle Modeling												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PS O-1	PS O- 2
CO-1	2	2	1	1	-	1	-	1	-	1	1	1	1	2
CO-2	2	1	2	2	1	-	1	1	-	2	1	2	2	1
CO-3	1	2	1	2	-	-	-	1	-	1	1	1	1	2
CO-4	2	2	1	2	-	2	1	2	2	2	1	2	2	1
CO-5	2	1	1	2	1	-	-	1	-	1	1	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: State Estimation and Optimizing													(9L)	
Introduction to State Estimation and Optimizing – methodology - method of least squares - State Estimation - Linear and Nonlinear Kalman Filters - GNSS/INS Sensing for Pose Estimation - LIDAR Sensing - An Autonomous Vehicle State Estimator - CARLA simulator. <i>Practice - CARLA simulator – Introduction</i>													CO-1 BTL-3	
MODULE 2: Path Planning Techniques													(9L)	
Introduction Path Planning – Methodology - discrete path planning and algorithms - Prediction - behavior of moving objects - behavior planning in a self-driving car - build candidate trajectories for the vehicle to follow. <i>Practice- Design path planning system using MATLAB Automated Driving Toolbox</i>													CO-2 BTL-3	
MODULE 3: Autonomy and Decision Making													(9L)	
Reinforcement learning, conflict learning and HMM learning - motion planning and model-based diagnosis, Markov decision processes and hidden Markov models (HMM Introduction to ROS - Packages and Catkin Workspaces. <i>Practice- Writing ROS Nodes – introduce Carla</i>													CO-3 BTL-3	
MODULE 4: Vehicle control and Actuation													(9L)	

Introduction to Vehicle control and Actuation – methods – introduction to PID Control - implement a PID control logic in Matlab to maneuver the vehicle around the track <i>Practice- Design vehicle control system using MATLAB Automated Driving Tool Box</i>		CO-4 BTL-3
MODULE 5: Longitudinal & Lateral Vehicle Modeling and control		(9L)
<i>Longitudinal and lateral dynamic models for a vehicle and create controllers that regulate speed and path tracking performance using Matlab.</i>		CO-5 BTL-3
TEXT BOOKS		
1.	Amditis A., Lytrivis P., Portouli E., Sensing and Actuation in Intelligent Vehicles, Handbook of Intelligent Vehicles. Springer, 2012.	
2.	Kalman, H Infinity, Dan Simon, Optimal State Estimation, Repro book, 2016.	
3.	Umar Zakir Abdul Hamid, Volkan Sezer “Path Planning for Autonomous Vehicle” Hard cover-Import, 2019.	
REFERENCES		
1.	Soudbakhsh D., Eskandarian A. Vehicle Lateral and Steering Control. In: Eskandarian A. (eds) Handbook of Intelligent Vehicles. Springer, 2012.	
2.	https://carla.readthedocs.io/en/latest/start_introduction	

LIST OF COURSES UNDER THE HONORS IN ELECTRIC VEHICLES AND E- MOBILITY:

SEMESTER - V									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1.	HN	EAT51908	Hybrid Vehicles	3	0	0	3	1	3
SEMESTER - VI									
2.	HN	EAT51909	Battery Technology and Management	3	0	0	3	1	3
SEMESTER - VII									
3.	HN	EAT51910	Advanced Propulsion System for Electric Drive Vehicles	3	0	0	3	1	3
4.	HN	EAT51911	Energy Storage Devices and Systems	3	0	0	3	1	3
Total Credits							12		

V SEMESTER:

COURSE TITLE	HYBRID VEHICLES			CREDITS	3
COURSE CODE	EAT51908	COURSE CATEGORY	HN	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course provides knowledge on hybrid vehicles and its components				

Course Objectives	1. To develop requirements of hybrid vehicles 2. To demonstrate the various types of Induction motors 3. To discuss the different types of motors and controllers 4. To analyze the significance of electric vehicle design consideration 5. To demonstrate different types of Hybrid vehicles													
Course Outcomes	Upon completion of this course, the students will be able to 1. Develop requirements of hybrid vehicles 2. Demonstrate the various types of induction motors 3. Discuss the different types of motors and controllers 4. Analyse the significance of electric vehicle design consideration 5. Demonstrate different types of Hybrid vehicles													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PS O-1	PS O-2
CO-1	2	1	2	2	1	2	1	-	2	2	1	2	2	1
CO-2	1	2	1	2	-	-	-	1	-	1	-	1	1	2
CO-3	2	1	1	1	-	2	1	-	2	2	1	2	2	1
CO-4	1	1	1	2	1	-	-	1	-	1	-	1	1	2
CO-5	1	1	1	1	-	-	-	1	-	1	-	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1- REQUIREMENT FOR HYBRID VEHICLES													(9L)	
Need of E-mobility - E-Mobility Policy - Performance comparison of conventional, electric and hybrid vehicles- Layout of E -vehicle- Specification of electric and hybrid vehicles – Case study													CO-1 BTL-2	
MODULE 2 – CONFIGURATION OF HYBRID VEHICLES													(9L)	
Types of Hybrids - Series, Parallel, Split – Parallel, Series - Parallel - Advantages and Disadvantages. Power split device - Energy Flow – Energy Management System - Design consideration													CO-2 BTL-2	
MODULE 3 – DRIVES AND CONTROL													(9L)	
Introduction to drives- Principles- Classification- Construction- Power, Torque and speed curves- Power requirements and calculation- Torque Production, Equivalent Circuit- Types of operation – Control Methods													CO-3 BTL-3	
MODULE 4 - INDUCTION MOTORS													(9L)	
Induction Motors – Principles - Classification – Construction - Working – Characteristics - Speed control Methods													CO-4 BTL-3	
MODULE 5 – HYBRID VEHICLE DESIGN CONSIDERATION													(9L)	
Aerodynamic - Rolling resistance - Transmission efficiency - Vehicle mass- Electric vehicle chassis and Body design considerations- Heating and cooling systems- Controllers- Power steering- Tyre choice- Wing Mirror, Aerials and Luggage racks													CO-5 BTL-3	
TEXT BOOKS														
1.	James Larminie and John Lowry, “Electric Vehicle Technology “ John Wiley & Sons,2013													
2.	Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2013													
3.	MehrdadEhsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press,2015													
REFERENCE BOOKS														
1.	Ron HodKinson, “light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication,2015.													
2.	Lino Guzzella, “Vehicle Propulsion System” Springer Publications,2015.													

VI SEMESTER:

COURSE TITLE	BATTERY TECHNOLOGY AND MANAGEMENT			CREDITS	3
COURSE CODE	EAT51909	COURSE CATEGORY	HN	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	36 th ACM	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME														
First Periodical Assessment		Second Periodical Assessment		Seminar/ Assignments/ Project				Surprise Test / Quiz		Attendance			ESE	
15%		15%		10%				5%		5%			50%	
Course Description		This course provides knowledge on battery technology and its management												
Course Objectives		1. To discuss on electrochemical energy storage 2. To develop concepts on major battery chemistries and testing 3. To design on recent technology changes in battery 4. To examine on advancement in battery technology 5. To demonstrate about batteries for Automotives.												
Course Outcomes		Upon completion of this course, the students will be able to 1. Discuss on electrochemical energy storage 2. Develop concepts on major battery chemistries and testing 3. Design on recent technology changes in battery 4. Examine on advancement in battery technology 5. Demonstrate about batteries for Automotives.												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PS O-1	PS O-2
CO-1	2	1	2	2	1	2	1	-	2	2	1	1	2	1
CO-2	1	2	1	2	-	1	-	1	-	1	-	1	1	2
CO-3	2	1	2	1	-	2	1	-	2	2	1	2	2	1
CO-4	1	2	1	2	1	-	-	1	-	1	-	1	1	2
CO-5	1	1	1	1	-	-	-	1	-	1	1	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 - INTRODUCTION TO ELECTROCHEMICAL ENERGY STORAGE													(9L)	
Introduction to battery technologies Electromotive force- Reversible cells- Relation between electrical energy and energy content of a cell-Free energy changes and electromotive force in cell- Current challenges in Energy storage Technologies.													CO-1 BTL-2	
MODULE 2 - MAJOR BATTERY CHEMISTRIES DEVELOPMENT AND TESTING													(9L)	
Battery performance evaluation- Primary battery - Service time- Voltage data- Service life – ohmic load curve- Effect of operating temperature on service life. Secondary batteries- Discharge curves Terminal voltages- Plateau voltage –Lead acid Batteries – Construction and application.													CO-2 BTL-2	
MODULE 3 – RECENT TECHNOLOGIES -1													(9L)	
Recent development of electrode materials in lithium-ion batteries- Recent development of solid electrolytes and their application to solid state batteries-Polymer solid electrolytes for lithium-ion conduction													CO-3 BTL-3	
MODULE 4 – RECENT TECHNOLOGIES - 2													(9L)	
Thin Film solid state Batteries: Fundamentals, Construction, and application – Super Capacitors: Fundamental, Construction and application.													CO-4 BTL-3	
MODULE 5 - BATTERIES FOR AUTOMOTIVES – FUTURE PROSPECTS													(9L)	
Degrees of vehicle electrification – Battery size vs. application -USABC and DOE targets for vehicular energy storage systems – Analysis and Simulation of batteries - Equivalent circuit and life modelling – Environmental concerns in battery production – recycling of batteries													CO-5 BTL-2	
TEXT BOOKS														
1.	T.Minami, M.Tatsumisago, M.Wakihara, C. Iwakura,S. Kohijiya, Solid state ionics for batteries, Springer Publication, 2012.													
2.	Sandeep Dhameja, Electric Vehicle Battery Systems, Newness publication, 2011.													
REFERENCE BOOKS														
1	Bard, Allen J., and Larry R. Faulkner. Electrochemical Methods: Fundamentals and Applications. 2nd ed., Wiley– VCH, Verlag, GmbH, 2011.													

2	Masataka Wakihara and Osamu Yamamoto, Lithium-ion Batteries Fundamental and Performance, Wiley–VCH, Verlag GmbH, 2012.
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VII SEMESTER:

COURSE TITLE	ADVANCED PROPULSION SYSTEM FOR ELECTRIC DRIVE VEHICLES							CREDITS				3		
COURSE CODE	EAT51910			COURSE CATEGORY		HN		L-T-P-S				3-0-0-1		
Version	1.0			Approval Details		36th ACM		LEARNING LEVEL				BTL-3		
ASSESSMENT SCHEME														
First Periodical Assessment	Second Periodical Assessment			Seminar/ Assignments/ Project		Surprise Test / Quiz		Attendance				ESE		
15%	15%			10%		5%		5%				50%		
Course Description	This course provides knowledge on various motors and its applications.													
Course Objectives	1. To discuss on the fundamentals of permanent magnet brushless DC motors. 2. To develop concepts of permanent synchronous magnet motors 3. To demonstrate concepts of switched reluctance motors 4. To determine the concepts of stepper motors and its applications 5. To demonstrate the basic concepts of other special machines													
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on fundamentals of permanent magnet brushless DC motors. 2. Develop concepts of permanent synchronous magnet motors 3. Demonstrate concepts of switched reluctance motors 4. Determine the concepts of stepper motors and its applications 5. Demonstrate the basic concepts of other special machines													
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO- 7	PO -8	PO -9	PO -10	PO -11	PO -12	PS O-1	PSO -2
CO-1	2	1	2	1	1	2	1	-	2	2	1	2	2	1
CO-2	1	2	1	2	-	-	-	1	-	1	-	1	1	2
CO-3	2	1	1	1	-	2	1	-	2	1	1	2	2	1
CO-4	1	1	1	2	1	-	-	1	-	1	-	1	1	2
CO-5	1	1	1	1	-	-	-	1	-	1	-	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1- PERMANENT MAGNET BRUSHLESS DC MOTORS (9L)														

Fundamentals of Permanent Magnets-Types-Principle of operation-Magnetic circuit analysis-EMF and Torque Equations-Characteristics and control	CO-1 BTL-2
MODULE 2- PERMANENT MAGNET SYNCHRONOUS MOTORS (9L)	
Principle of operation –EMF and Torque equations -Phasor diagram -Power controllers –Torque speed characteristics –Digital controllers –Constructional features, operating principle and characteristics of synchronous reluctance motor.	CO-2 BTL-2
MODULE 3 - SWITCHED RELUCTANCE MOTORS (9L)	
Constructional features –Principle of operation-Torque prediction–Characteristics Power controllers –Control of SRM drive-Sensor less operation of SRM –Applications.	CO-3 BTL-3
MODULE 4 – STEPPER MOTORS (9L)	
Constructional features –Principle of operation –Types –Torque predictions –Linear and Non-linear analysis –Characteristics –Drive circuits –Closed loop control –Applications.	CO-4 BTL-2
MODULE 5 - OTHER SPECIAL MACHINES (9L)	
Principle of operation and characteristics of Hysteresis motor –AC series motors –Linear motor –Applications.	CO-5 BTL-2
TEXT BOOKS	
1.	T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Claredon press, London, 2010.
2.	R. Krishnan, 'Switched Reluctance motor drives', CRC press, 2012.
REFERENCE BOOKS	
1.	R.Krishnan, ' Electric motor drives' , Prentice hall of India,2012.
2.	D.P.Kothari and I.J.Nagrath, ' Electric machines', Tata Mc Graw hill publishing company, New Delhi, Third Edition, 2014.

COURSE TITLE	ENERGY STORAGE DEVICES AND SYSTEMS			CREDITS	3
COURSE CODE	EAT51911	COURSE CATEGORY	HN	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	36th ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course gives knowledge on energy storage devices and systems				

Course Objectives	1. To discuss on electrical energy storage technologies 2. To illustrate the needs for electrical energy storage 3. To examine the features of energy storage systems 4. To develop electrochemical energy storage systems 5. To demonstrate energy storage systems													
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on electrical energy storage technologies 2. Illustrate the needs for electrical energy storage 3. Examine the features of energy storage systems 4. Develop electrochemical energy storage systems 5. Demonstrate energy storage systems													
Prerequisites:														
CO, PO AND PSO MAPPING														
CO	PO -1	PO- 2	PO -3	PO- 4	PO- 5	PO -6	PO- 7	PO- 8	PO -9	PO -10	PO- 11	PO -12	PS O-1	PS O-2
CO-1	2	1	2	2	1	2	1	-	2	2	1	2	2	1
CO-2	1	2	1	2	-	-	-	1	-	1	-	1	1	2
CO-3	2	1	1	1	-	2	1	-	2	2	1	2	2	1
CO-4	1	1	1	2	1	-	-	1	-	1	-	1	1	2
CO-5	1	1	1	1	-	-	-	1	-	1	-	1	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1- ELECTRICAL ENERGY STORAGE TECHNOLOGIES (9L)														
Characteristics of Electricity, Electricity, and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, long distance between generation and consumption, Congestion in power grids, Transmission by cable.													CO-1 BTL-2	
MODULE 2- NEEDS FOR ELECTRICAL ENERGY STORAGE (9L)														
Emerging needs for EES, more renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.													CO-2 BTL-2	
MODULE 3 - FEATURES OF ENERGY STORAGE SYSTEMS (9L)														
Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2), Synthetic natural gas (SNG).													CO-3 BTL-3	
MODULE 4 - ELECTROCHEMICAL ENERGY STORAGE SYSTEMS (9L)														
Batteries: Primary, Secondary batteries; difference between primary and secondary batteries, chemistries of primary batteries such as Zinc-Carbon, Alkaline. Advantages, disadvantages, limitations and application each above mentioned batteries.													CO-4 BTL-2	
MODULE 5 - ENERGY STORAGE SYSTEMS (9L)														

Secondary batteries such as Lead acid, Nickel Cadmium, Metal hydrides, lithium ion, lithium phosphate and high temperature batteries- sodium-sulphur. Advantages, disadvantages, limitations and application each above mentioned batteries.		CO-5 BTL-2
TEXT BOOKS		
1.	“James M. Eyer, Joseph J. Iannucci and Garth P. Corey “, “Energy Storage Benefits and Market Analysis”, Sandia National Laboratories, 2014.	
REFERENCE BOOKS		
1.	“Jim Eyer, Garth Corey”, Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.	
2.	O’Hayre, SW Cha, W Colella and FB Prinz, “Fuel Cell Fundamentals”, Wiley, 2005	
3.	Xianguo Li, “Principles of Fuel Cells”, Taylor and Francis, 2005	