22EEHO303	ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL	SEMESTER			
PREREQUISITES	**CATEGORY**	**PEC**	**Credit**		**3**
Power Electronics and Electrical Machines	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To learn the basics of EV and vehicle mechanics
2.	To know the EV architecture and to study the energy storage system concepts
3.	To derive model for batteries and to know the different types of batteries and its charging methods
4.	To learn the control preliminaries for DC-DC converters.

UNIT I	**INTERNAL COMBUSTION ENGINES**	**9**	**0**	**0**	**9**

IC Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control Systems, Treatment of Diesel Exhaust Emissions, Comparison of Internal Combustion Engine and Electric Vehicle, Review of light-, medium-, and heavy-duty all-electric vehicles.

UNIT II	**ELECTRIC VEHICLES AND VEHICLE MECHANICS**	**9**	**0**	**0**	**9**

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT III	**BATTERY MODELING, TYPES AND CHARGING**	**9**	**0**	**0**	**9**

Batteries in Electric and Hybrid Vehicles - Battery Basics -Battery Parameters. Types- Lead Acid Battery - Nickel-Cadmium Battery - Nickel-Metal-Hydride (Ni MH) Battery - Li-Ion Battery - Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulphur Battery, Sodium-Metal-Chloride, Research and Development for Advanced Batteries. Battery Modelling, Electric Circuit Models. Battery Pack Management, Battery Charging.

UNIT IV	**CONTROL PRELIMINARIES**	**9**	**0**	**0**	**9**

Control Design Preliminaries - Introduction - Transfer Functions – Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode.

UNIT V	**CONTROL OF AC MACHINES**	**9**	**0**	**0**	**9**

Introduction- Reference frame theory, basics-modeling of induction and synchronous machine in various frames-Vector control- Direct torque control.

Total (45L+0T) = 45 Periods

Reference Books:

1.	Electric and Hybrid Vehicles, Design Fundamentals, Third Edition, Iqbal Husain, CRC Press, 2021.
2.	Power Electronic Converters,: Dynamics and Control in Conventional and Renewable Energy Applications, Teuvo Suntio, Tuomas Messo, Joonas Puukko, 1st Edition, Wiley - VCH.
3.	Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems”, Special Indian Edition, Marcel dekker, Inc 2003, 1st Edition.
4.	C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press, 2001, 1st Edition.
5.	Wie Liu, “Hybrid Electric Vehicle System Modeling and Control”, Second Edition, John Wiley & Sons, 2017, 2nd Edition.
6.	Dynamic Simulation of Electric Machinery using MATLAB, Chee Mun Ong, Prentice Hall,1997, 1st Edition.
7.	Electrical Machine Fundamentals with Numerical Simulation using MATLAB/ SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley, 2021, 1st Edition

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	To describe the concepts related with EV, HEV and to compare the same with internal combustion engine vehicles	L2: Understanding
CO2	:	To find gain margin & phase margin for various types of transfer functions of boost converter	L5: Evaluating
CO3	:	To demonstrate the Control of A.C Machines	L3: Applying
CO4	:	To explain the concepts related with batteries and parameters of battery	L4: Analyzing
CO5	:	To module the battery and to study the research and development for batteries	L6: Creating

COURSE ARTICULATION MATRIX

COs/ POs	**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**	**PS O3**
CO1	3								1	2		2	3		3
CO2	3								1	2		2	3		3
CO3	3						3		1	2		2	3		3
CO4	3						3		1	2		2	3		3
CO5	3						3		1	2		2	3	2	3
Avg	3	0	0	0	0	0	3	0	1	2	0	2	3	2	3

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)