PROGRAMME ELECTIVE COURSE VERTICALS FOR HONOURS / MINOR DEGREE

VERTICAL III: ELECTRIC VEHICLE TECHNOLOGY

22EEHO301	ELECTRIC VEHICLE ARCHITECTURE			SEMESTER			
PREREQUISTIES		CATEGORY		PEC	Credit		3
		Hours/Week		L	T	P	TH
Electric Drives, Energy management, Electric Vehicles				3	0	0	3
Course Objectives:							
1.	To provide knowledge about electric vehicle architecture and power train components.						
2.	To know the concepts of dynamics of electrical vehicles						
3.	To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)						
4.	To understand the concept of energy storage systems						
5.	To provide knowledge about different energy sources and energy management in HEVs.						
UNIT I	**HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS**			**9**	**0**	**0**	**9**
History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.							
UNIT II	**MECHANICS OF HYBRID ELECTRIC VEHICLES**			**9**	**0**	**0**	**9**
Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity.							
UNIT III	**CONTROL OF DC AND AC MOTOR DRIVES**			**9**	**0**	**0**	**9**
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives							
UNIT IV	**ENERGY STORAGE SYSTEMS**			**9**	**0**	**0**	**9**
Battery: Principle of operation, types, models, estimation of parameters, battery modeling, SOC of battery, Traction Batteries and their capacity for standard drive cycles, Vehicle to Grid operation of EV's. Alternate sources: Fuel cells, Ultra capacitors, Fly wheels.							
UNIT V	**HEV CONTROL STRATEGY AND ENERGY MANAGEMENT**			**9**	**0**	**0**	**9**
HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneratio mode - series parallel mode - energy management of HEV's.							
Total (45L+0T)= 45 Periods							

Text Books:	
1.	Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2011.
2.	Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017.
Reference Books:	
1.	James Larminie and John Lowry, 'Electric Vehicle Technology Explained', Second Edition, 2012.
2.	Goodarzi, Gordon A., Hayes, John G, Electric power train: energy systems, power electronics & drives for hybrid, electric & fuel cell vehicles, Wiley 2018
3.	De Doncker, Rik, Pulle, Duco W.J., Veltman, Andre, Advanced Electrical Drives, First Edition, CRC Press, Taylor and Francis Group, 2011.
4.	Mehradad Eshani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Fundamentals, Theory and Design, Second Edition, CRC Press, Taylor and Francis Group, 2010.
	RiK De Doncker, Advanced Electric Drives – Analysis , Modeling ,Control, Springer publications
E-Reference	
1	https://nptel.ac.in/courses/108/106/108106170/
2	https://nptel.ac.in/courses/108/102/108102121/

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Learn the electric vehicle architecture and power train components.	L1: Remembering
CO2	:	Acquired the concepts of dynamics of electrical vehicles	L2: Understanding
CO3	:	Apply the vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs).	L3: Applying
CO4	:	Ability to design and select energy storage systems.	L6: Creating
CO5	:	Evaluate different energy sources and energy management in HEVs.	L5: Evaluating

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	2	2	2	2	2	2	2	2	1	1	1	1	2	1	1
CO2	2	2	2	2	2	2	2	2	1	1	1	1	2	1	1
CO3	2	2	2	2	2	2	2	2	1	1	1	1	2	1	1
CO4	2	2	2	2	2	2	2	2	1	1	1	1	2	1	1
CO5	2	2	2	2	2	2	2	2	1	1	1	1	2	1	1
Avg	2	2	2	2	2	2	2	2	1	1	1	1	2	1	1

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