III Year I Semester **L T P C**

Code:20EE5638 **4 0 0 4**

SPECIAL MACHINES FOR ELECTRIC AND HYBRID VEHICLES

Preamble: This course enables the students to understand the performance of various electrical machines used in electric and hybrid vehicles.

Course Objectives

1. Introduce the fundamental concepts and principles of electric and hybrid electric vehicles drive train topologies
2. Develop a thorough understanding of the key elements of EV/HEV: Electric Machines for Propulsion Applications and Energy Sources
3. Understand the structure and performance of electric machines used in electric vehicles

Course Outcomes

1. Demonstrate the impact of modern vehicles on energy supplies
2. Outline the structures of various electric machines used in electric vehicles
3. Develop the mathematical models of various electric machines used in electric vehicles
4. Assess the performance of various electric machines used in electric vehicles
5. Explain the speed control mechanisms of various electric machines used in electric vehicles

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3	1					2				2		3
CO2			3	1					2				2		3
CO3			3	1					2				2		3
CO4			3	1					2				2		3
CO5			3	1					2				2		3

1 – Weak, 2 – Moderate and 3 – Strong

Unit – I: Introduction to Hybrid Electric Vehicles **12 Hours**

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance, drive cycles.

Unit – II: Architecture of Electric and Hybrid Electric Vehicles **12 Hours**

Hybrid Electric Drive-trains- Introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.
Electric Drive-trains- Introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Unit – III: DC Machines **12 Hours**

Structure of DC machines used in electric vehicles-radial tangential flux-internal, external rotor, hybrid excited machine, Steady state characteristics of DC machines, Dynamic model of DC machines, Control of DC machines.

Unit – IV: Induction Machines and Switched Reluctance machines **12 Hours**

Structure of induction machines, Steady state characteristics of induction machines, Dynamic model of induction machines, Control of induction machines.

Constructional features and operation of switched reluctance machines (SRM), Steady state characteristics of SRM, Dynamic model of SRM, Control of SRM.

Unit – V: Brushless Machines **12 Hours**

Principle of operation, Types, Magnetic circuit analysis, EMF and torque equations, Commutation, Motor characteristics and control, Applications.

Steady state characteristics of permanent magnet synchronous machine (PMSM), Dynamic model of PMSM motor, Control of PMSM motor.

Text Books:

1. K. T. Chau, "Electric Vehicle Machines and Drives - Design, Analysis and Application", Wiley, IEEE Press, 2015
2. Husain, I. "Electric and Hybrid Vehicles", Boca Raton, CRC Press, 2010.

Reference Books:

1. Tariq Muneer and Irene Illescas García, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017.
2. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013