



**SREENIVASA INSTITUTE of TECHNOLOGY and MANAGEMENT
STUDIES (autonomous)**

ELECTRIC VEHICLES

Question bank

IV - B.TECH / VII - SEMESTER

regulation: R20

Compiled by

FACULTY INCHARGE : A.KEERTHI

Designation : ASSISTANT PROFESSOR

Department : EEE



Pre-requisites: A Course on Power system Engineering, Power Electronics

Course Educational Objectives:

- 1 Understand Electric and Hybrid Electric Vehicles
- 2 Study and analyze the Energy Storage for EV and HEV
- 3 Study and understand the concept of Electric Propulsion
- 4 Analyze and design the Electric and Hybrid Electric Vehicles
- 5 Study operation of Power Electronic Converter for Battery Charging.

UNIT –1 ELECTRIC AND HYBRID ELECTRIC VEHICLES

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.

UNIT – 2: ENERGY STORAGE FOR EV AND HEV

Energy storage requirements, Battery parameters, Types of Batteries, Modeling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Super Capacitors.

UNIT – 3: ELECTRIC PROPULSION

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

UNIT – 4: DESIGN OF ELECTRIC AND HYBRID ELECTRIC VEHICLES

Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, and design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, and energy storage design.

UNIT – 5: POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING

Charging methods for battery, Termination methods, charging from grid, The Z- converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, Highfrequency transformer based isolated charger topology, Transformer less topology.



SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

(Autonomous)

DEPARTMENT of ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

Electric vehicles(20EEE474)

Course Outcomes:

SNO	DESCRIPTION	PO'S & PSO'S
CO.1	Understand Electric and Hybrid Electric Vehicles	PO1,PO2,PO3
CO.2	Study and analyze the Energy Storage for EV and HEV	PO1,PO2,PO3
CO.3	Study and understand the concept of Electric Propulsion	PO1,PO2,PO3
CO.4	Analyze and design the Electric and Hybrid Electric Vehicles	PO1,PO2,PO3
CO.5	Study operation of Power Electronic Converter for Battery Charging.	PO1,PO2,PO3

Text Books:

- 1.CM. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, " Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2005.
- 2.Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.

REFERENCE BOOKS:

1. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
- 2.C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001.
- 3.Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Wiley Publication, 2011.



SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

(Autonomous)

DEPARTMENT of ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

Electric vehicles(20EEE474)

QUESTION BANK

Question No.	Questions	PO Attainment
UNIT – 1: ELECTRIC AND HYBRID ELECTRIC VEHICLES		
PART-A (Two Marks Questions)		
1	Define rolling resistance.	PO1
2	Define aero dynamic drag.	PO1
3	What is tractive effort.	PO1
4	Define speed ratio.	PO1
5	What are the types subsystems in electric vehicle.	PO1
6	Draw the diagram of primary electric vehicle.	PO1
7	What are the types of electric vehicle.	PO1
8	Compare electric vehicle and hybrid electric vehicle.	PO1
9	What are the types of hybrid electric vehicle.	PO1
10	What are the components of electric vehicle.	PO1
11	Define clutch ,differentiator ,and vehicle controller.	PO1
12	Draw the traction motor characteristics of electric vehicle.	PO1
13	Define gradability ,maximum speed ,maximum cruising speed and acceleration time.	PO1
14	Draw the tractive effort and speed characteristics.	PO1
15	Write the torque equation and velocity equation of electric vehicle.	PO1
16	Define energy consumption.	PO1
17	What are the operating modes of series hybrid electric drive train.	PO1
18	What is pure engine mode and pure electric mode.	PO1
19	What id regenerative.	PO1
20	Define electric traction motor.	PO1
PART-B (Ten Marks Questions)		
1	Elucidate the general layout of electric vehicle.	PO1, PO2
2	Draw the architecture of hybrid electric drive train.	PO1, PO2, PO4
3	What are the traction motor characteristics of electric vehicle and explain.	PO1, PO2
4	Derive the expression for vehicle performance characteristics of electric vehicle.	PO1, PO2, PO4
5	Explain the different configuration of electric vehicle.	PO1, PO2, PO4
6	What is series hybrid electric drive train and explain with neat sketch.	PO1, PO2, PO4
7	What is parallel hybrid electric drive train and explain with neat sketch.	PO1, PO2, PO4
8	What are different configurations of parallel hybrid electric drive train.	PO1, PO2, PO4

Question No.	Questions	PO Attainment
UNIT – 2: ENERGY STORAGE FOR EV AND HEV		



SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

(Autonomous)

DEPARTMENT of ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

Electric vehicles(20EEE474)

PART-A (Two Marks Questions)		
1	What is battery.	PO1
2	What are the battery parameters.	PO1
3	Mention energy storage requirements.	PO1
4	What are the types of batteries in electric vehicle and hybrid electric vehicle.	PO1
5	Define fuel cell.	PO1
6	What are the types of fuel cell.	PO1
7	Classify the lithium based batteries.	PO1
8	What is lead acid battery.	PO1
9	Classify the nickel based batteries.	PO1
10	Define ultra capacitor.	PO1
PART-B (Ten Marks Questions)		
1	Explain the nickel based batteries.	PO1, PO3
2	Explain the lithium based batteries.	PO1, PO3
3	Explain the lead acid batteries.	PO1, PO3
4	What are the types of battery models and explain.	PO1, PO2, PO3
5	Explain PEMFC with neat sketch.	PO1, PO2, PO3
6	What are the merits and demerits of the typical lead acid battery ?Also explain Working principle of a Li-ion battery with a neat sketch and necessary equation involved.	PO1, PO2, PO3
7	Define battery charge capacity with example.	PO1, PO2, PO3
8	Mention any two types of batteries.	PO1, PO2, PO3
Question No.	Questions	PO Attainment
UNIT – 3: ELECTRIC PROPULSION		
PART-A (Two Marks Questions)		
1	What are the types of DC motors.	PO1
2	Give the example for commutator less device.	PO1
3	Classify the topologies of power converter.	PO1
4	Mention the hardware for electronic control.	PO1
5	Mention the software for electronic control.	PO1
6	Write the types of electric motors.	PO1
7	What are the types of motor drives.	PO1
8	What are the types of devices in power converter for electric vehicle.	PO1
9	Define duty cycle.	PO1
10	What are the control strategies of chopper.	PO1
11	Comment on the suitability of AC and DC methods for electric and hybrid electric applications.	PO1, PO3
12	What is meant by constant power speed ratio as applied to an electric motor.	PO1
13	Justify the usage of PMSM in electric vehicle application.	PO1, PO3
14	Compare the induction and BLDC motor with respect to electric vehicle application.	PO1, PO3
15	Give the examples of commutator devices.	PO1
16	What is the basic principle of induction motor.	PO1



SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

(Autonomous)

DEPARTMENT of ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

Electric vehicles(20EEE474)

17	What is meant by constant torque method speed ratio as applied in electric vehicle.	PO1
18	Write the advantages of SRM.	PO1
19	Mention the applications of BLDC Motor.	PO1
20	Mention the applications of Induction motor.	PO, PO3
PART-B (Ten Marks Questions)		
1	Explain the control strategies of chopper.	PO1, PO3, PO4
2	What is the need of power device in motor? Explain the working principle of the power drive system used to switched reluctance motor with relevant sketch.	PO1, PO3, PO4
3	Explain the working principle and component involved in the control system process of typical BLDC motor with relevant schematic sketch.	PO1, PO3, PO4
4	How do you control speed of an induction motor.	PO1, PO3, PO4
5	Explain the working principle of Induction motor as applied in electric vehicles.	PO1, PO3, PO4
6	Explain the working principle of DC motor as applied in electric vehicles.	PO1, PO3, PO4
7	Compare BLDC motor and Switched Reluctance motor.	PO1, PO3, PO4
8	Mention the differences between commutator and commutator less devices.	PO1, PO3, PO4
9	Explain the Speed control methods of DC motor.	PO1, PO3, PO4
10	Explain the torque speed characteristics of SRM.	PO1, PO3, PO4

Question No.	Questions	PO Attainment
UNIT – 4: DESIGN OF ELECTRIC AND HYBRID ELECTRIC VEHICLES		
PART-A (Two Marks Questions)		
1	Define gradeability.	PO1
2	Justify the need of transmission system in EV.	PO1
3	What is peaking power source.	PO1
4	What are the types of hybrid electric drive train.	PO1, PO2
5	What is series hybrid drive train.	PO1, PO2
6	What are the control strategies of series hybrid drive train.	PO1, PO2
7	Mention the control strategies of parallel hybrid drive train.	PO1, PO2
8	What is parallel hybrid drive train.	PO1, PO2
9	What are the components of series hybrid electric drive train.	
10	Mention the components of parallel hybrid electric drive train.	

11 What is the function of motor controller.

12 What is traction motor.

PART-B (Ten Marks Questions)		
1	What is the need of control system in hybrid vehicle? explain the process of energy control using energy management system in a typical series hybrid vehicle with a neat schematic sketch.	PO1, PO2, PO3, PO6



SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

(Autonomous)

DEPARTMENT of ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

Electric vehicles(20EEE474)

2	Elaborate the overall power train architecture and components of the typical electric scooter with relevant schematic sketch.	PO1, PO2, PO3, PO6
3	Explain Explain the sizing the power electronics to hybrid vehicle.	PO1, PO2, PO3, PO6
4	Elaborate the control strategies of series hybrid electric drive train.	PO1, PO2, PO3, PO6
5	Elaborate the control strategies of parallel hybrid electric drive train.	PO1, PO2, PO3, PO6
6	What are the operation pattern of series hybrid electric drive train.	PO1, PO2, PO3, PO6
7	What are the operation pattern of parallel hybrid electric drive train.	PO1, PO2, PO3, PO6

Question No.	Questions	PO Attainment
UNIT – 5: POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING		
<u>PART-A (Two Marks Questions)</u>		
1	Mention the charging methods of battery.	PO1
2	What is wireless battery.	PO1
3	What are the classifications of EV charger.	PO1
4	What are the requirements of the EV charging system.	PO1
5	What are the termination methods of battery.	PO1
6	What is onboard charger.	PO1
7	Define offboard charger.	PO1
8	What is constant current method.	PO1
9	What is constant voltage method.	PO1
10	Draw the characteristics of constant current and constant voltage method.	PO1
<u>PART-B (Ten Marks Questions)</u>		
1	Explain the charging methods of battery as applied in electric vehicles.	PO1, PO7
2	Termination methods of battery as applied in EV.	PO1, PO7
3	How electric vehicle charging from grid explain.	PO1, PO7
4	Discuss the working of isolated DC to DC converter.	PO1, PO7
5	Explain the DC fast charging system.	PO1, PO7
6	Explain constant voltage and constant current method of battery.	PO1, PO7
7	Explain the Z converter as applied in EV and HEV.	PO1, PO7

ALL THE VERY BEST