



SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

(Autonomous)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

**ELECTRIC VEHICLES – 20EEE474
(Skill Oriented Course)**

&

**ELECTRIC VEHICLE TECHNOLOGY – 200EEE472
(OPEN ELECTIVE – 4)**

Question bank

IV - B.TECH / VII - SEMESTER

Regulation : R20

Faculty In charge: Mrs. B. K. Shalini

Designation : Assistant Professor

Department : Electrical and Electronics Engineering



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, High frequency transformer based isolated charger topology, Transformer less topology.



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Course Outcomes:

S.NO.	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.
Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles and Applications with Practical Perspectives, Wiley Publication, 2011.

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	3	2	2	-	-	-	-	-	-	-	-	-	2	-
C02	3	2	2	-	-	-	-	-	-	-	-	-	2	-
C03	3	2	2	-	-	-	-	-	-	-	-	-	2	-
C04	3	2	2	-	-	-	-	-	-	-	-	-	2	-
C05	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO*	3	2	2	-	-	-	-	-	-	-	-	-	2	-



UNIT-1: ELECTRIC AND HYBRID ELECTRIC VEHICLES

2-MARKS QUESTIONS:

1. Define rolling resistance.
2. Define aero dynamic drag.
3. What is tractive effort?
4. Define speed ratio.
5. What are the type's subsystems in electric vehicle?
6. Draw the diagram of primary electric vehicle.
7. What are the types of electric vehicle?
8. Compare electric vehicle and hybrid electric vehicle.
9. What are the types of hybrid electric vehicle?
10. What are the components of electric vehicle?
11. Define clutch, differentiator, and vehicle controller.
12. Draw the traction motor characteristics of electric vehicle.
13. Define grad ability, maximum speed, maximum cruising speed and acceleration time.
14. Draw the tractive effort and speed characteristics.
15. Write the torque equation and velocity equation of electric vehicle.
16. Define energy consumption.
17. What are the operating modes of series hybrid electric drive train?
18. What is pure engine mode and pure electric mode?
19. What is regenerative?
20. Define electric traction motor.

10- MARKS QUESTIONS:

1. Elucidate the general layout of electric vehicle.
2. Draw the architecture of hybrid electric drive train.
3. What are the traction motor characteristics of electric vehicle and explain.
4. Derive the expression for vehicle performance characteristics of electric vehicle.
5. Explain the different configuration of electric vehicle.
6. What is series hybrid electric drive train and explain with neat sketch.
7. What is parallel hybrid electric drive train and explain with neat sketch.
8. What are different configurations of parallel hybrid electric drive train?

UNIT-2: ENERGY STORAGE FOR EV AND HEV

2-MARKS QUESTIONS:

1. What is battery?
2. What are the battery parameters?
3. Mention energy storage requirements.
4. What are the types of batteries in electric vehicle and hybrid electric vehicle?
5. Define fuel cell.
6. What are the types of fuel cell?
7. Classify the lithium based batteries.
8. What is lead acid battery?



SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

9. Classify the nickel based batteries.
10. Define ultra-capacitor.

10-MARKS QUESTIONS:

1. Explain the nickel based batteries.
2. Explain the lithium based batteries.
3. Explain the lead acid batteries.
4. What are the types of battery models and explain.
5. Explain PEMFC with neat sketch.
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.
7. Define battery charge capacity with example.
8. Mention any two types of batteries and explain the modelling of battery
9. Write Principle and Operation of Fuel Cells and Explain Different Types of Fuel Cells.
10. Explain in detailed about Super Capacitors, PEM Fuel Cells.

UNIT-3: ELECTRIC PROPULSION

2-MARKS QUESTIONS:

1. What are the types of DC motors?
2. Give the example for commutator less device.
3. Classify the topologies of power converter.
4. Mention the hardware for electronic control.
5. Mention the software for electronic control.
6. Write the types of electric motors.
7. What are the types of motor drives?
8. What are the types of devices in power converter for electric vehicle?
9. Define duty cycle.
10. What are the control strategies of chopper?
11. Comment on the suitability of AC and DC methods for electric and hybrid electric applications.
12. What is meant by constant power speed ratio as applied to an electric motor.
13. Justify the usage of PMSM in electric vehicle application.
14. Compare the induction and BLDC motor with respect to electric vehicle application.
15. Give the examples of commutator devices.
16. What is the basic principle of induction motor?
17. What is meant by constant torque method speed ratio as applied in electric vehicle.
18. Write the advantages of SRM.
19. Mention the applications of BLDC Motor.
20. Mention the applications of Induction motor.

10-MARKS QUESTIONS:

1. Explain the general layout of EVs. Draw the different configurations by considering the electric propulsion system.
2. Explain the control strategies of chopper.
3. 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.



SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

4. Explain the working principle and component involved in the control system process of typical BLDC motor with relevant schematic sketch.
5. How do you control speed of an induction motor?
6. Explain the working principle of Induction motor as applied in electric vehicles.
7. Explain the working principle of DC motor as applied in electric vehicles.
8. Compare BLDC motor and Switched Reluctance motor.
9. Mention the differences between commutator and commutator less devices.
10. Explain the Speed control methods of DC motor used in electric vehicles. Discuss their impact on vehicle performance and efficiency?
11. Explain the torque speed characteristics of SRM.

UNIT-4: DESIGN OF ELECTRIC AND HYBRID ELECTRIC VEHICLES

2-MARKS QUESTIONS:

1. Define grade ability.
2. Justify the need of transmission system in EV.
3. What is peaking power source.
4. What are the types of hybrid electric drive train?
5. What is series hybrid drive train?
6. What are the control strategies of series hybrid drive train?
7. Mention the control strategies of parallel hybrid drive train.
8. What is parallel hybrid drive train?
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?

10-MARKS QUESTIONS:

1. Why is energy management control system required in an HEV? Elaborate an EMS similar to that applied to a hybrid vehicle, is required in an EV.
2. Explain the Operating Modes in a series HEV drive train with a neat sketch.
3. Explain the operating patterns and control strategies used in series hybrid electric drive train design.
4. 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.
5. Elaborate the overall power train architecture and components of the typical
6. Explain electric scooter with relevant schematic sketch.
7. Explain the sizing of the power electronics to hybrid vehicle.
8. Elaborate the control strategies of series hybrid electric drive train.
9. Elaborate the control strategies of parallel hybrid electric drive train.
10. What are the operation pattern of series hybrid electric drive train?
11. What are the operation pattern of parallel hybrid electric drive train?
12. Explain the design of electric motor drive capacity, transmission design and energy storage design in detail.



UNIT-5: POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING

2-MARKS QUESTIONS:

1. Mention the charging methods of battery.
2. What is wireless battery?
3. What are the classifications of EV charger?
4. What are the requirements of the EV charging system?
5. What are the termination methods of battery?
6. What is onboard charger?
7. Define off board charger.
8. What is constant current method?
9. What is constant voltage method?
10. Draw the characteristics of constant current and constant voltage method.

10-MARKS QUESTIONS:

1. Explain the charging methods of battery as applied in electric vehicles.
2. Termination methods of battery as applied in EV.
3. How electric vehicle charging from grid explain.
4. Discuss the working of isolated bi-directional DC to DC converter.
5. Explain the DC fast charging system.
6. Explain constant voltage and constant current method of battery.
7. Explain the Z converter as applied in EV and HEV.
8. Explain in detail about DC-DC Converters used for EV and HEV applications.
9. Explain in detail about different types of battery charging methods.
10. Explain about high-frequency transformer based isolated charger topology, Transformer less topology.