SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur– 603203.

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

VII SEMESTER

1909701-ELECTRIC VEHICLES

Regulation–2019

Academic Year 2022-2023 (Odd Semester)

Prepared by

Mr. J.P.RAMESH, Assistant Professor (Sr.G.) / MECH

Mr. S. PRADEEP, Assistant Professor (O.G.) / MECH

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur 603 203.

DEPARTMENT OF MECHANICAL ENGINEERING

1909701-ELECTRIC VEHICLES **L T P C**

QUESTION BANK **3 0 0 3**

UNIT-I NEED FOR ALTERNATIVE SYSTEM

History of electric and hybrid vehicles. Need of electric and hybrid vehicles – comparative study of diesel, petrol, electric and hybrid vehicles. Limitations of electric vehicles. Specification of different electric and hybrid vehicles.

PART-A (2 Marks)

Q.No.	Questions	BT Level	Competence
1.	Highlight the history of hybrid electric vehicle.	BT-1	Remembering
2.	What are the major challenges facing implementation of hybrid and electric vehicle?	BT-2	Understanding
3.	Define hybrid vehicle.	BT-2	Understanding
4.	What is the need and importance of electric and hybrid vehicle?	BT-2	Understanding
5.	Mention the importance of electric vehicles.	BT-2	Understanding
6.	Why do we need hybrid vehicles?	BT-1	Remembering
7.	Compare hybrid and electric vehicle.	BT-2	Understanding
8.	What are the limitations of electric vehicles when compared to petrol and diesel vehicles?	BT-1	Remembering
9.	What are the 4 different types of hybrid vehicles?	BT-1	Remembering
10.	Comparisons of hybrid electric vehicles and conventional vehicles.	BT-1	Remembering
11.	Define mean effective pressure.	BT-1	Remembering
12.	In an Otto cycle, compression ratio is 8. Calculate the air standard cycle efficiency.	BT-3	Applying
13.	Describe the expression for mean effective pressure for diesel cycle.	BT-3	Applying
14.	Draw the Diesel cycle on P-V and T-S planes and mention the four thermodynamic processes involved.	BT-2	Understanding
15.	What is the order of customer preference for buying an electric vehicle?	BT-2	Understanding

16.	What are the challenges involved in using electric vehicles?	BT-2	Understanding
17.	Mention three disadvantages in electric cars.	BT-1	Remembering
18.	Why electric cars are not successful?	BT-1	Remembering
19.	Discuss about advantages to electric cars?	BT-1	Remembering
20.	Point out few applications of electric cars.	BT-1	Remembering
21.	What are the specifications of electric vehicles?	BT-2	Understanding
22.	Discuss about electric vehicles heated.	BT-1	Remembering
23.	What are the main components of electric and hybrid vehicles?	BT-1	Remembering
24.	What are the specifications of hybrid vehicles?	BT-1	Remembering
25.	Define performance characteristics of lubricants in electric and hybrid vehicles.	BT-1	Remembering

PART-B (13 Marks)

Q.No	Questions	Marks	BT Level	Competence
1	Explain historical development of automobile and development of interest and activity in the EV from 1890 to present day.	13	BT-1	Remembering
2	Compare series hybrid and parallel hybrid system with their merits and demerits.	13	BT-5	Evaluating
3	Explain need and importance of transportation development.	13	BT-3	Applying
4	Explain basic of vehicle performance with its characterization.	13	BT-6	Creating
5	Compare diesel and hybrid vehicle with their merits and demerits.	13	BT-3	Applying
6	Explain electric vehicle & its components.	13	BT-5	Evaluating
7	Compare petrol and hybrid vehicle with their merits and demerits.	13	BT-2	Understanding
8	a) Which are the different challenges for EV design.	6	BT-3	Applying
	b) Explain in detail Tractive Effort of electric vehicle.	7	BT-2	Understanding
9	Explain detail about limitations of electric vehicles.	13	BT-5	Evaluating
10	Explain detail about specification of different hybrid vehicles.	13	BT-2	Understanding

11	Compare petrol and electric vehicle with their merits and demerits.	13	BT-1	Remembering
12	Explain hybrid electric vehicle & its components.	13	BT-5	Evaluating
13	Explain detail about specification of different electric vehicles.	13	BT-2	Understanding
14	Compare petrol and electric vehicle with their merits and demerits.	13	BT-2	Understanding
15	With the help block diagram explain the major components of an electric vehicle.	13	BT-2	Understanding
16	Explain detail about specification of different hybrid vehicles.	13	BT-2	Understanding
17	Compare diesel and petrol vehicle with their merits and demerits.	13	BT-2	Understanding
18	Explain need and importance of electric and hybrid vehicles.	13	BT-2	Understanding

PART-C (15 Marks)

S.No	Questions	Marks	BT Level	Competence
1	Explain hybrid electric vehicle design and application.	15	BT-4	Analyzing
2	Discuss about case study on adding an electric car to a household.	15	BT-4	Analyzing
3	Explain electric vehicle design and application.	15	BT-2	Understanding
4	Discuss about Case Studies – Consumers Perspective cost analysis of market available EV with convectional vehicle.	15	BT-4	Analyzing
5	Draw six different configurations of drive trains in electric vehicles. Briefly explain each configuration.	15	BT-2	Understanding

UNIT-II ENERGY STORAGE DEVICES AND FUEL CELLS

Electromechanical batteries- types of batteries –lead acid batteries, nickel-based batteries, lithium-based batteries, Electro-chemical reactions, Thermodynamic voltage, specific energy, specific power, energy efficiency and Ultra-Capacitors. Fuel Cell- Fuel cell characteristics- Fuel cell types – Applications- Connecting cell in series-water management in the Polymer Exchange Membrane PEM fuel cell- Thermal Management of the PEM fuel cell.

PART-A (2 Marks)

Q.No.	Questions	BT Level	Competence
1.	Define electromechanical batteries.	BT-2	Understanding
2.	List out different types of Batteries.	BT-2	Understanding
3.	What are the common problems associated with lead acid batteries?	BT-2	Understanding
4.	Which electrolyte is used in lead acid battery?	BT-2	Understanding
5.	Why do lead acid batteries need water?	BT-2	Understanding
6.	List out three types of lead acid batteries.	BT-1	Remembering
7.	Define nickel-based batteries.	BT-2	Understanding
8.	Differentiate lithium battery and a regular battery.	BT-1	Remembering
9.	What happens if you charge a lithium battery with a regular charger?	BT-1	Remembering
10.	Classify four types of electrochemical cells.	BT-2	Understanding
11.	What is a battery?	BT-1	Remembering
12.	Define thermodynamic voltage.	BT-2	Understanding
13.	Define specific energy of battery.	BT-2	Understanding
14.	What is use of ultra-capacitors in electric vehicle?	BT-2	Understanding
15.	List four factors determine the power of a fuel cell.	BT-2	Understanding
16.	Mention limitations of fuel cells.	BT-2	Understanding
17.	Define fuel cells.	BT-1	Remembering
18.	Classify any four types of Fuel cells.	BT-1	Remembering
19.	How is a fuel cell different than a battery?	BT-2	Understanding
20.	What is the catalyst in a fuel cell?	BT-1	Remembering
21.	List any four application of the fuel cells?	BT-1	Remembering
22.	What factor is increased by connecting cells in series?	BT-1	Remembering

23.	Define PEM full cell.	BT-1	Remembering
24.	What is the electrolyte in PEM?	BT-1	Remembering
25.	What is operating temperature in PEM fuel cell?	BT-1	Remembering

PART-B (13 Marks)				
Q.No	**Questions**	**Marks**	**BT Level**	**Competence**
1	Define the terms charge capacity, specific energy, energy density, specific power, charge efficiency, energy efficiency, C rate for batteries.	13	BT-1	Remembering
2	With neat diagram, explain the construction and working of lead acid batteries.	13	BT-5	Evaluating
3	Explain the basic principle of super capacitors based energy storage system in hybrid electric vehicles?	13	BT-2	Understanding
4	Explain detail about PEM fuel cell.	13	BT-6	Creating
5	Explain about Lithium Based Batteries in Energy Storage System?	13	BT-3	Applying
6	Explain about nickel-based batteries in energy storage system?	13	BT-5	Evaluating
7	Explain working principle and benefits of Ultra capacitor energy storage.	13	BT-2	Understanding
8	Why Balancing of cells is required in battery? Explain Active cell balancing method.	13	BT-2	Understanding
9	What is Battery Management System? Explain its function.	13	BT-2	Understanding
10	a) Explain the difference between ultra-capacitor and battery as an energy storage device for EV.	8	BT-2	Understanding
	b) What are the main issues with fuel cells?	5	BT-4	Analyzing
11	Explain thermal monitoring of battery unit.	13	BT-1	Remembering
12	Explain battery-based energy storage and its analysis in detail.	13	BT-4	Analyzing
13	Explain different charging algorithm and balancing method for battery pack charging.	13	BT-2	Understanding

14	What are different modes of charging batteries? Compare them in detail.	13	BT-2	Understanding
15	What are the battery parameters? Explain each briefly.	13	BT-2	Understanding
16	Explain the working principle of a fuel-cell and its analysis.	13	BT-2	Understanding
17	Explain detail about thermal management of the PEM fuel cell.	13	BT-2	Understanding
18	Classify and explain full cell with application.	13	BT-2	Understanding

PART-C (15 Marks)				
S.No	**Questions**	**Marks**	**BT Level**	**Competence**
1	Classify and explain the different energy management strategies.	15	BT-4	Analyzing
2	Explain lead-acid battery schematic and physical structure.	15	BT-4	Analyzing
3	Discuss about fuel cell characteristics and types.	15	BT-4	Analyzing
4	Classify and explain thermal management of the PEM fuel cell.	15	BT-2	Understanding
5	Discuss about types of batteries with merits and demerits.	15	BT-2	Understanding

UNIT-III PROPULSION MOTORS AND CONTROLLERS

Types of electric motors – working principle of AC and DC motors. Characteristic of shunt, series and compound type of DC motors- permanent magnet and separately exited DC motors. AC single phase and 3-phase motor – inverters – DC and AC motor speed controllers.

PART-A (2 Marks)

Q.No.	Questions	BT Level	Competence
1.	Define Electric motors.	BT-1	Remembering
2.	What are the application of DC motors in electric vehicle?	BT-1	Remembering
3.	Why series motor cannot be started on no-load?	BT-2	Understanding
4.	Mention the methods for starting an induction motor?	BT-2	Understanding
5.	What is 2 phase motor?	BT-2	Understanding
6.	What is working principle of AC motor?	BT-1	Remembering
7.	List different types of electric motors.	BT-1	Remembering
8.	What is working principle of DC motor?	BT-1	Remembering
9.	Mention the characteristics of DC series.	BT-1	Remembering
10.	How the characteristic of DC series motor differs from DC shunt motor?	BT-2	Understanding
11.	List out the applications of DC compound motor.	BT-1	Remembering
12.	What is a permanent magnet motor used for?	BT-1	Remembering
13.	How is the speed of a permanent magnet motor controlled?	BT-1	Remembering
14.	What are the advantages of PMDC motors?	BT-1	Remembering
15.	Define hysteresis torque.	BT-2	Understanding
16.	Why separately excited dc motor is used?	BT-2	Understanding
17.	Mention the characteristics of separately excited dc motor.	BT-1	Remembering
18.	How do you control a separately excited dc motor?	BT-1	Remembering
19.	What is separate excitation?	BT-2	Understanding
20.	What is 3-phase and single phase?	BT-1	Remembering

21.	What is the difference between 1 and 3-phase?	BT-1	Remembering
22.	List three types of inverters.	BT-1	Remembering
23.	Define MPPT in inverter?	BT-1	Remembering
24.	How speed controlled in DC and AC motors?	BT-1	Remembering
25.	What are the factors that control the speed of a DC motor?	BT-1	Remembering

PART-B (13 Marks)

Q.No	Questions	Marks	BT Level	Competence
1	Briefly explain working principle of AC and DC motors.	13	BT-1	Remembering
2	List the types of electric motors and explain.	13	BT-5	Evaluating
3	a) What are the factors on which the sizing of electric motors for electric vehicle depends? b) What are the desired features of electric motor used in electric vehicles?	7 6	BT-3	Applying
4	Explain the four-quadrant operation of speed control of DC motor driven electric vehicle.	13	BT-6	Creating
5	How the electric motors used in EVs differs from that of used in industrial application?	13	BT-3	Applying
6	Explain the two-quadrant operation of chopper DC motor drive with suitable waveforms for electric vehicle.	13	BT-3	Applying
7	Briefly explain i)Series wound DC motors ii)Shunt wound DC motors.	13	BT-2	Understanding
8	With neat diagram explain brushless DC motors.	13	BT-3	Applying
9	Explain compound wound DC motors with neat circuit diagram and also write the voltage and current equations.	13	BT-5	Evaluating
10	Discuss different methods of control used for DC-DC controlled drives in EV.	13	BT-2	Understanding
11	Explain detail about permanent magnet and separately exited DC motors.	13	BT-1	Remembering

12	Discuss about the speed control methods of series motor.	13	BT-1	Remembering
13	a) Discuss about advantages and disadvantages of AC and DC motors for Electric vehicle applications. b) What is the advantage of AC motor over DC motors for EV applications?	7 6	BT-2	Understanding
14	Explain Characteristic of shunt and compound type of DC motors.	13	BT-2	Understanding
15	Explain with neat diagram of resistance start induction AC motors.	13	BT-2	Understanding
16	Explain construction and working principle of three-phase Induction motor.	13	BT-2	Understanding
17	Explain working of AC series motor with necessary Diagrams.	13	BT-2	Understanding
18	Explain working of AC motor speed controllers with necessary diagrams.	13	BT-2	Understanding

PART-C (15 Marks)				
S.No	**Questions**	**Marks**	**BT Level**	**Competence**
1	Explain characteristics of series and compound type of DC Motor.	15	BT-4	Analyzing
2	Case study of load test on dc shunt motor with neat diagram.	15	BT-4	Analyzing
3	Discuss about the speed control methods of shunt motor.	15	BT-4	Analyzing
4	Explain four types of DC motors and their characteristics.	15	BT-4	Analyzing
5	Explain the principles of DC and AC motor speed control.	15	BT-3	Applying

UNIT-IV VEHICLE LAYOUT

Electric vehicle layout, specifications, system components, electronic control system, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, energy consumption, safety and challenges in electric vehicles.

PART-A (2 Marks)

Q.No.	Questions	BT Level	Competence
1.	Mention the specifications of electric vehicles.	BT-2	Understanding
2.	What are the main components in the electric vehicle?	BT-2	Understanding
3.	Define electric control system.	BT-2	Understanding
4.	What are the main components of an EV battery?	BT-2	Understanding
5.	Where do the components for EV batteries come from?	BT-2	Understanding
6.	How do electric cars control speed?	BT-1	Remembering
7.	List the main function of controller in EV.	BT-1	Remembering
8.	How does motor controller work?	BT-1	Remembering
9.	What are the components used in motor control circuit?	BT-1	Remembering
10.	Why DC motor speed control is important?	BT-2	Understanding
11.	List the two types of motor controllers.	BT-1	Remembering
12.	How is the performance in electric vehicles?	BT-3	Applying
13.	Why electric cars better in performance?	BT-2	Understanding
14.	What are the factors affecting the performance of batteries used in electric vehicles?	BT-2	Understanding
15.	What are the characteristics that a traction motor should possess?	BT-2	Understanding
16.	How does a traction motor work?	BT-2	Understanding
17.	List the main characteristics of traction drives.	BT-1	Remembering
18.	What are the characteristics of a good traction system?	BT-1	Remembering
19.	Define tractive effort.	BT-1	Remembering

20.	List three factors contribute to engine generated tractive effort the most.	BT-1	Remembering
21.	What type of transmission system is used in electric vehicle?	BT-2	Understanding
22.	How do you calculate the energy consumption of an electric car?	BT-2	Understanding
23.	What is the consumption of electric vehicles?	BT-2	Understanding
24.	Mention the challenges faced with electric vehicle presently.	BT-2	Understanding
25.	What are the challenges faced by current electric vehicle design and technology?	BT-2	Understanding

PART-B (13 Marks)				
Q.No	**Questions**	**Marks**	**BT Level**	**Competence**
1	Explain advantages and challenges in electric vehicle design.	13	BT-1	Remembering
2	Obtain the mathematical modeling of electric vehicle to describe its performance.	13	BT-5	Evaluating
3	Explain different components and configuration of Electric Vehicles.	13	BT-3	Applying
4	Explain need of energy consumption in EV and HEV.	13	BT-6	Creating
5	Explain basic of vehicle performance with its characterization.	13	BT-3	Applying
6	With the help of neat figure explain the epicyclic gear transmission system used in electric vehicle.	13	BT-5	Evaluating
7	Discuss in detail about the control of permanent magnet motor drives.	13	BT-2	Understanding
8	Explain performance characteristics of BLDC drives.	13	BT-3	Applying
9	Explain safety feature in the electric vehicle.	13	BT-5	Evaluating
10	a) Why there is a need for hybrid energy storage? Explain different combination.	8	BT-2	Understanding
	b) Explain various factors which determines performance of vehicle.	5	BT-4	Analyzing
11	With the help of block diagram explain the major components of an electric vehicle.	13	BT-1	Remembering
12	Explain energy consumption of Electric Vehicle.	13	BT-1	Remembering

13	Classify and explain the basic principles of rule-based energy management system.	13	BT-2	Understanding
14	Explain the general electric vehicle configuration with the help of block diagram.	13	BT-2	Understanding
15	Explain challenges related to electric vehicles and possible solutions.	13	BT-2	Understanding
16	With necessary diagram explain each part of the V2G electric vehicle.	13	BT-2	Understanding
17	Explain the fuel cell energy production technology in electric vehicle with neat sketch.	13	BT-2	Understanding
18	Explain hybrid electronic control unit and its classification.	13	BT-2	Understanding

PART-C (15 Marks)				
S.No	**Questions**	**Marks**	**BT Level**	**Competence**
1	Draw a general lay out of a EV and discuss the transmission characteristics.	15	BT-4	Analyzing
2	Explain rolling resistance and aerodynamic drag in vehicles.	15	BT-4	Analyzing
3	Describe the mathematical models to determine vehicle performance.	15	BT-4	Analyzing
4	Draw six different configurations of drivetrains in electric vehicles. Briefly explain each configuration.	15	BT-4	Analyzing
5	Why an energy management control system is required in an HEV? Do you think an elaborate energy management system similar to that applied to a hybrid vehicle, is required in an electric vehicle? Explain.	15	BT-4	Analyzing

UNIT-V HYBRID VEHICLES			
Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, hybrid electric drive train design, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles.			
PART-A (2 Marks)			
Q.No.	**Questions**	**BT Level**	**Competence**
1.	Define hybrid electric drive trains.	BT-1	Remembering
2.	List various types of hybrid electric drive trains.	BT-2	Understanding
3.	Mention two main types of hybrid vehicles.	BT-1	Remembering
4.	What is the purpose of a hybrid?	BT-2	Understanding
5.	List the most important component of the hybrid vehicle.	BT-2	Understanding
6.	What is the difference between series and parallel hybrid?	BT-1	Remembering
7.	Mention any four merits of series hybrid electric drive train.	BT-2	Understanding
8.	What are the main components of a hybrid driving system?	BT-1	Remembering
9.	List main categories of hybrid system.	BT-1	Remembering
10.	Mention any four demerits of parallel hybrid electric drive train.	BT-2	Understanding
11.	Define series hybrid electric drive train.	BT-2	Understanding
12.	What is the difference between mild hybrid and full hybrid?	BT-1	Remembering
13.	Define full hybrid electric vehicle.	BT-1	Remembering
14.	Define parallel hybrid electric drive train.	BT-1	Remembering
15.	Mention two main types of hybrid vehicle.	BT-1	Remembering
16.	What is difference between hybrid and plug-in hybrid?	BT-2	Understanding
17.	Define purpose of a hybrid.	BT-1	Remembering
18.	List advantage of PHEV over HEV?	BT-1	Remembering
19.	Define mild hybrid electric vehicle.	BT-5	Evaluating
20.	List advantages of hybrid vehicles.	BT-1	Remembering
21.	Define plug-in hybrid electric vehicle.	BT-2	Understanding

22.	What is the difference between hybrid and electric vehicle?	BT-2	Understanding
23.	List advantage of a range extended hybrid vehicle.	BT-1	Remembering
24.	Mention any four benefits of hybrid electric drive trains.	BT-1	Remembering
25.	List the optimization based strategies in hybrid electrical Vehicles.	BT-2	Understanding

PART-B (13 Marks)

Q.No	Questions	Marks	BT Level	Competence
1	Illustrate the power flow control in hybrid electric drive train.	13	BT-1	Remembering
2	Compare series hybrid and parallel hybrid system with their merits and demerits.	13	BT-5	Evaluating
3	Explain the need of drive cycle for HEVs and hence explain different drive cycles.	13	BT-3	Applying
4	Explain about fly wheel technologies in hybrid electric vehicles.	13	BT-6	Creating
5	Explain various hybrid drive train.	13	BT-3	Applying
6	Which are the various PHEV control strategies? Explain any one in detail.	13	BT-5	Evaluating
7	Explain hybridization of energy storage for hybrid Vehicles.	13	BT-2	Understanding
8	Which are the various Hybrid drive train topologies?	5	BT-3	Applying
	Explain hybrid electric vehicle & its components.	8	BT-2	Understanding
9	Explain Hybridization of drive trains in HEV's.	13	BT-5	Evaluating
10	a) Write a short note on sizing the power electronics to hybrid vehicles.	7	BT-2	Understanding
	b) Write a short notes on fuel efficiency analysis in hybrid electric drive-trains.	6	BT-4	Analyzing
11	Explain concept and architecture of HEV drive train.	13	BT-1	Remembering
12	With the help of block diagram explain the basic architecture of hybrid electric vehicle and specify the energy savings potentials of HEV.	13	BT-1	Remembering
13	Draw and explain architecture and power flow control	13	BT-2	Understanding

	of series hybrid electric vehicle.			
14	Draw and explain typical CAN system of an HEV.	13	BT-2	Understanding
15	With a neat sketch, explain the configuration of series hybrid electric drive train.	13	BT-2	Understanding
16	Compare conventional vehicle with Hybrid electric vehicle.	13	BT-5	Evaluating
17	Discuss the history of hybrid electric vehicles.	13	BT-2	Understanding
18	With a neat sketch, explain the range extended hybrid electric vehicle.	13	BT-2	Understanding

PART-C (15 Marks)

S.No	Questions	Marks	BT Level	Competence
1	Explain the design of a hybrid electric vehicle as a case study.	15	BT-4	Analyzing
2	What are the techniques to improve range and performance of hybrid electric vehicles and explain with detail.	15	BT-4	Analyzing
3	Draw and explain architecture and power flow control of parallel hybrid electric vehicle.	15	BT-4	Analyzing
4	Enlist the different architectures of hybrid electric drive train and explain the series hybrid electric drive train.	15	BT-5	Evaluating
5	Explain the different power flow control modes of a typical parallel hybrid system with the help of block diagrams.	15	BT-5	Evaluating

****