

# **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 2025-2026 (Odd Semester)**

*Prepared by*

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## DEPARTMENT OF MECHANICAL ENGINEERING

1909701-ELECTRIC VEHICLES

L T P C

QUESTION BANK

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### 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 primary challenges to the adoption of electric and hybrid vehicles?                   | BT-1     | Remembering   |
| 3.    | Define hybrid vehicle.   | BT-1     | Remembering   |
| 4.    | What is the need of electric vehicle?  | BT-2     | Understanding |
| 5.    | Mention the importance of electric vehicles.   | BT-1     | Remembering   |
| 6.    | Why do we need hybrid vehicles?  | BT-2     | Understanding |
| 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.   | Compare hybrid electric vehicles with conventional vehicles.                                       | BT-2     | Understanding |
| 11.   | Define mean effective pressure.  | BT-1     | Remembering   |
| 12.   | In an Otto cycle, compression ratio is 8. Calculate the air standard cycle efficiency.             | BT-2     | Understanding |
| 13.   | Describe the expression for mean effective pressure for diesel cycle.                              | BT-2     | Understanding |
| 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 |

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| 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-2 | Understanding |
| 19. | Discuss about advantages of 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 heat transfer.                                    | 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 automobiles and development of interest and activities in the EV from 1890 to present day. | 13    | BT-4     | Analyzing     |
| 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-4     | Analyzing     |
| 4    | Explain the basics 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 |

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|----|--|----|------|---------------|
| 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   |

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| 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 |

| <b>PART-B (13 Marks)</b> |  |              |                 |                   |
|--------------------------|--|--------------|-----------------|-------------------|
| <b>Q.No</b>              | <b>Questions</b>   | <b>Marks</b> | <b>BT Level</b> | <b>Competence</b> |
| 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     |

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| 14 | What are different modes of charging batteries?<br>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 |  |    | 2    | Understanding |

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|-------------|
|             |
| <b>S.No</b> |
| 1           |
| 2           |
| 3           |
| 4           |
| 5           |



|              |                   |
|--------------|-------------------|
|              |                   |
| <b>Level</b> | <b>Competence</b> |
| 1            | Analyzing         |
| 1            | Analyzing         |
| 1            | Analyzing         |
| 2            | Understanding     |
| 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 excited 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   |

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|-----|--|------|-------------|
| 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?<br>b) What are the desired features of electric motor used in electric vehicles? | 7<br>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 excited DC motors.   | 13     | BT-1     | Remembering   |

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|----|--|--------|------|---------------|
| 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.<br>b) What is the advantage of AC motor over DC motors for EV applications? | 7<br>6 | BT-2 | Understanding |
| 14 | Explain Characteristic of shunt and compound type of   | 13     | BT-2 | Understanding |
| 15 |  |        |      | Understanding |
| 16 |  |        |      | Understanding |
| 17 |  |        |      | Understanding |
| 18 |  |        |      | Understanding |



| S.No |  |    | vel  | Competence |
|------|--|----|------|------------|
| 1    |  |    | 4    | Analyzing  |
| 2    |  |    | 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 |

| <b>PART-B (13 Marks)</b> |   |              |                 |                   |
|--------------------------|---|--------------|-----------------|-------------------|
| <b>Q.No</b>              | <b>Questions</b>  | <b>Marks</b> | <b>BT Level</b> | <b>Competence</b> |
| 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       |

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| 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 . . . . .                      | 13 | BT-2 | Understanding |
| 17 |  |    |      | Understanding |
| 18 |  |    |      | Understanding |



| S.No |   | vel | Competence        |
|------|---|-----|-------------------|
| 1    |   | 4   | Analyzing         |
| 2    |   | 4   | Analyzing         |
| 3    |   | 4   | Analyzing         |
| 4    | electric vehicles. Briefly explain each configuration.  | 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<br>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)**

| <b>S.No</b> | <b>Questions</b>  | <b>Marks</b> | <b>BT Level</b> | <b>Competence</b> |
|-------------|---|--------------|-----------------|-------------------|
| 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        |

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