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**21AU52**

## Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
### Fundamentals of Electrical Vehicles

Time: 3 hrs.                                                                 Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

1  a.  Explain the historical development of electric vehicles.                    **(08 Marks)**
   b.  Discuss the carbon emission from fuels in vehicle.                          **(06 Marks)**
   c.  Describe Greenhouse gases and pollutants formed by vehicle.                **(06 Marks)**

#### OR

2  a.  Explain the need of electric drive and major issues of electric vehicles at present.  **(04 Marks)**
   b.  With neat layout, explain Battery Electric Vehicle.                        **(06 Marks)**
   c.  Explain the following with neat layout:
       (i)   Series Hybrid Electric Vehicle
       (ii)  Parallel Hybrid Electric Vehicles                                   **(10 Marks)**

### Module-2

3  a.  Briefly explain the following:
       (i)   Vehicle load forces
       (ii)  Aerodynamic drag
       (iii) Rolling resistance                                                  **(12 Marks)**
   b.  A vehicle needs to run continuously at 60 kmph and should have a peak torque of 150 Nm. A motor gives peak torque of 25 Nm at 3000 rpm. What should be the gear ratio and minimum tyre radius (in m) for the motor to be used by the vehicle?  **(08 Marks)**

#### OR

4  a.  Describe regenerative braking of the vehicle with neat diagram.           **(08 Marks)**
   b.  Explain simple drive cycle for vehicle comparison.                        **(06 Marks)**
   c.  Assume a vehicle has $r_{wheel}$ of 0.3 m. Convert speeds of:
       i)   1000 rpm in kmph and m/sec
       ii)  2 m/sec into kmph and rpm
       iii) 80 kmph into m/sec and rpm                                           **(06 Marks)**

### Module-3

5  a.  Sketch and explain the working of a :
       (i) Lead acid battery          (ii) Nickel-metal hydride battery          **(10 Marks)**
   b.  What are the battery parameters? Explain briefly.                         **(06 Marks)**
   c.  A battery is of 48 V, 30 Ah is designed to power an electric two wheeler. Battery is designed to operate at 80% DoD (Depth of Discharge) and end of life is considered when the capacity falls to 70% of its initial capacity.
       Compute the total energy content in the battery (in KWh). What is the maximum amount of usable energy available (in KWh) for each cycle at beginning of life and at end of life.  **(04 Marks)**

**OR**

6  a. Write short note on battery management system. **(06 Marks)**
   b. Explain following methods of battery rating:
   (i) Cold Cranking Amps                (ii) Cranking Amps (CA)
   (iii) Watt-hour (Wh)                   (iv) Ampere-hour (Ah) **(10 Marks)**
   c. Battery has initial rated capacity of 10 KWh at 48 V. Battery is charged using standard charging conditions. Coulomb counting indicates a charge of 30 Ah has flown in before termination of charge. What will be the % SoC change when : (i) SoH (State of Health is 90% and (ii) SoH is 85% (here SoH refers to capacity fade, SoC = State of Charge) **(04 Marks)**

## Module-4

7  a. With neat sketch, explain construction and operation of AC motor. **(10 Marks)**
   b. Explain operation of DC generator with neat sketch. **(10 Marks)**

**OR**

8  a. Describe weight and size and performance parameters in electric vehicles. **(10 Marks)**
   b. Explain construction and working principle of DC motor with sketch. **(10 Marks)**

## Module-5

9  a. With neat block diagram, explain fuel cell electric vehicle system. **(10 Marks)**
   b. With neat sketch, explain alkaline fuel cell, clearly stating the chemical reactions. **(10 Marks)**

**OR**

10 a. Write a brief note on fuel cell characteristics. **(06 Marks)**
   b. Explain hydrogen storage systems and reformers. **(08 Marks)**
   c. Mention the challenges and solutions for hydrogen storage systems. **(06 Marks)**

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