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Paper Code : PE-EE 602A/PE-EEE 602A Electrical And Hybrid Vehicle

UPID : 006610

Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.

Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following :

[1 x 10 = 10]

- (I) A 100 Ahr battery is labeled with 0.1C rate having a discharge current of _____ A.
- (II) List the ECUs(Electronic Control Units) of a typical control architecture of HEV.
- (III) Define Hybridness or Hybrid factor of a HEV.
- (IV) What is nominal speed?
- (V) What are two different types of In-wheel drive used in EVs?
- (VI) What is the unit of charge capacity of a battery?
- (VII) Class C chopper operates in _____ & _____ quadrant
- (VIII) For a battery having depth of discharge of 20% and charge capacity is 500 Ahr, the maximum charge can be drawn from the battery is _____ Ahr
- (IX) What is CAN?
- (X) If a vehicle is solely powered by gasoline engine its Hybridness will be _____ %.
- (XI) Why in VVVF control of induction motor v/f ratio is kept constant?
- (XII) What is charge efficiency? On which parameters it is dependent?

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. Explain explain tractive effort with suitable diagram. [5]
3. Define Hybridness or Hybrid factor of a Vehicle. What is the design Philosophy of HEVs? [5]
4. Why fuel efficiency and emissions of a vehicle is mutually conflicting? [5]
5. Explain with diagrams EV drive train alternatives based on power source configuration. [5]
6. Explain State of Charge (SOC) and depth of discharge (DOD). [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. (a) What is series, mixed and range extender hybrid? Explain with block diagram. How the range extension can be achieved? What are the assumptions to be made to derive the equations of a range extender hybrid? [6+3+3]
- (b) A HEV has a range of 320 km. If $H = 75\%$. What is the range of the vehicle without engine and what is the gain in range the vehicle has achieved? [3]
8. (a) Explain the operation of a two quadrant chopper fed dc motor drive. [5]
- (b) Explain the methods of speed control of a DC separately excited motor. Why a series motor cannot be started at no-load? [2+3]
- (c) Explain why constant torque control is performed below base speed and constant power control above base speed? [5]
9. (a) Draw a simple parallel hybrid drive train and describe the modes of operation of the drive train that appreciate the complexity of the its control system [10]
- (b) What are the elements of control theory of an electric vehicle? Explain with an example [5]
10. (a) What is calendar life of a battery and how is it dependent on self-discharge rate of the battery? What is the second life of battery? [3+2]
- (b) What are the parameters on which the life cycle of a battery depends? What are the conditions to be maintained to obtain the maximum no. of cycles from Li-ion battery? [2+3]

(c) Explain the configuration and the working principle of Nickel based rechargeable batteries. [5]

11. (a) What are the desirable requirements of the electric motor used in EV? Compare the electric motors used in EV and industry applications. [3+4]

(b) A car is travelling on a paved road with drag coefficient (CD) = 0.35, projected frontal area (Af) = 1.95 m², weight = 1360 kg, density of air (ρ) = 1.225 kg/m³. Its engine is running at 3000 rpm and is producing 340 N-m of torque. The car's gear reduction ratio is 3.5 to 1, driveline efficiency 90%, mass factor 1.035 and dynamic radius of tire is 38 cm. What is the value of tractive effort on the driven wheel while driving on a level road and the speed & acceleration of the vehicle under this condition is of the vehicle under this condition. What is the time required for the vehicle to reach 0 to 100 km/hr under this condition. [8]

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