

[Time: 3 Hours]

- All questions are compulsory.
- Marks are mentioned on the right side of each question.

**Group (A)**

**Q.1 Choose the most suitable answer the following options.**

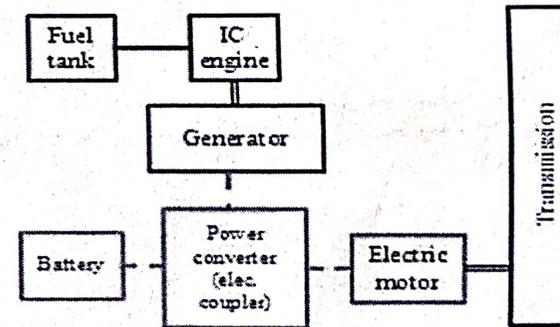
(1\*20=20)

- i. From where tractive effort is generated in EV  
(a) Battery (b) Converter (c) Driving Shaft  Motor
- ii. An EV only needs one of the following maintenance jobs done. Which is it?  
(a) Oil change (b) Belt replacement (c) New spark plugs  Brake pad inspections
- iii. It is difficult to use ultracapacitors alone as an energy storage for EVs and HEVs because of their  
(a) high specific energy density and the dependence of voltage on the SOC  
 low specific energy density and the dependence of voltage on the SOC  
(c) low specific energy density and the independence of voltage on the SOC  
(d) high specific energy density and the independence of voltage on the SOC
- iv. When a vehicle goes up or down a slope, its weight produces a component of force that is always directed \_\_\_\_\_  
(a) Upwards  Downwards (c) left ways (d) right ways
- v. Permanent magnet motors with sinusoidal air gap flux distribution are called  
 Permanent Magnet Synchronous Motors (b) Brushless DC motors  
(c) Brushless AC motors (d) Permanent Magnet induction Motors
- vi. The series parallel hybrid systems are classified into two categories \_\_\_\_\_ & the \_\_\_\_\_  
(a) Fuel Cell dominated; petrol engine dominated  
 ICE dominated; Electrical Motor dominated  
(c) Hydrogen cell dominated; petrol engine dominated  
(d) Hydrogen cell dominated; gas engine dominated
- vii. Which Battery are preferred for EV  
(a) Lead-acid (Pb-acid)  Lithium-ion (Li-ion) (c) Sodium-sulphur (NaS) (d) Nickel-cadmium (NiCd)
- viii. The Field Oriented Control (FOC) enables the induction machine being controlled alike the  
 separately excited DC Machine  
(b) Permanent magnet DC machine  
(c) Switched reluctance machine  
(d) Stepper motor

- ix. Which motor is suitable for high starting torque  
 DC Series motor  
(b) DC shunt Motor  
(c) DC separately Excited Motor  
(d) Synchronous Motor

- x. High specific energy, high specific power, long cycle life, high-energy efficiency, quick recharge, maintenance free characteristics, cost effectiveness, and environmental friendliness are the features of \_\_\_\_\_  
(a) Ultracapacitor  Battery (c) fuel cell (d) Flywheel
- xi. A battery labeled 200 Ah at C5 rate has a 200 amp-hour capacity at 5 hours discharge rate the discharging current will be \_\_\_\_\_. **Battery capacity = discharge current ~~at~~ C5 = 5 hr**  
(a) 25 Amps (b) 22.5 Amps (c) 27.5 Amps  40 Amps
- xii. Calculate the mass of the battery in series HEVs when battery power is 59600 kW and specific power of battery is 335 kW/kg  
 177.91 Kg (b) 200 Kg (c) 229.3 Kg (d) 150 Kg
- xiii. The ultra-capacitors are characterized by  
(a) Low specific Energy  
 High specific power and low specific energy  
(c) High specific energy and high specific power  
(d) Low specific power and Low specific Energy
- xiv. The figure shown below indicates which of the following HEV configuration?

**specific power = power/mass**



- Series Parallel (b) Series (c) Parallel (d) Complex
- xv. Calculate hybridness of a light delivery van with the propulsion: Diesel engine: 110 kW, Electric motor: 23 kW  
(a) 82%  17% (c) 21% (d) 47%
- xvi. Aerodynamic drag energy is directly proportional to  
 Velocity<sup>2</sup> (b) Velocity<sup>3</sup> (c) Velocity (d) Constant

xvii. In a hybrid electric vehicle one energy source is \_\_\_\_ & the other is a conversion of a \_\_\_\_

- (a) combustion, energy to fuel
- (b) storage, energy to fuel
- (c) storage, energy to energy
- ★ storage, Fuel to energy

xviii. When a vehicle goes up or down a slope, its weight produces a component force that is always directed \_\_\_\_

- (a) upwards
- ★ downwards
- (c) left ways
- (d) right ways

xix. .... hybrid vehicle is either propelled by ICE or battery.

- ★ Parallel
- (b) Series
- (c) Mild
- (d) Split

xx. Vehicle-to-grid (V2G) describes a system in which plug-in electric vehicles (PEV), communicate with the \_\_\_\_\_ to sell demand response services by either returning electricity to the grid or by throttling their charging rate

- (a) PEV
- (b) ICE vehicles
- ★ Power grid
- (d) Battery scooters

**Group (B)**

Q.2 Elaborate and compare the energy sources for EV and HEV, (b) explain the various types of Electric Vehicle. 4

OR

State the advantages and disadvantages of electric vehicle, (b) explain the major component of electric vehicle 4

Q.3 Explain the general characteristics of motors used in EV, (b) explain the different types of motor used in EV. 4

OR

Explain the various types of battery used in EVs. for energy storage, (b) Explain lead-acid battery with charging and discharging process 4

Q.4 Explain the need of BMS (Battery management system) in electric vehicle using Block diagram. 4

OR

Explain the following types of power electronics converter circuits: (a) DC to DC converter, (c) DC to AC converter 4

Q.5 Draw and explain the architecture of Series and Series -Parallel hybrid electric drive train and explain any one of them 4

OR

(a) What do you mean by diode? Explain the various types of diodes. (b) what are the different types of transistors used in EVs? 4

Syllabus

Q.6 Draw the schematic of general configuration of electrical subsystem of an Electric Vehicle (EV) and Hybrid Electric Vehicle (HEV). 4

OR

(a) Explain plug-in hybrid electric vehicle with advantages, disadvantages and application, (b) explain advantages disadvantages and applications of battery electric vehicle. 4

**Group (C)**

Q.7 Explain Lithium-ion battery charging and discharging process, merits and de-merits in contrast to their counterpart. 6

OR

State and define the key battery parameters (i) Battery capacity (ii) C rate (iii) SoC (iv) DoD (v) Specific Energy (vi) Energy Density. 6

Q.8 A lead acid battery of 240V, 120 Ah capacity is used for EV drive, provides average of 240wh/km to motor. Calculate distance covered in single charge. Assume efficiency as 90% and DOD as 50%. 6

OR

Calculate Peukert capacity of a battery of 130Ah with C10(10hr) rating and Peukert coefficient=1.2 6

Q.9 Explain the terms rolling resistance and aerodynamic drag in vehicles and derive the expression for vehicle translational speed from fundamentals 6

OR

Explain the motor selection criteria for a particular electric vehicle. 6

Q.10 State the Governments initiatives and promotion to encourage EV use in India. 6

OR

Elaborate on standards and polices adopted at the Global level for electric vehicles 6

Q.11 Describe the procedure of battery disposal and recycling. 6

OR

Define the carbon footprint and how EV can help in reducing it? 6

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