



B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2022

(Regulation 2018)

Seventh Semester

B.E AUTOMOBILE ENGINEERING

U18AUT7003: Hybrid and Electric Vehicles

COURSE OUTCOMES

- CO1:** Describe the configuration of hybrid and electric vehicles.
CO2: Identify the basic components of hybrid and electric vehicles.
CO3: Assess the characteristics and performance of the electric vehicle
CO4: Select suitable electric propulsion and control systems for HEV.
CO5: Choose proper energy storage systems for vehicle applications
CO6: Describe the operation of fuel cell and solar cell vehicles.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

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|--|-----|-------------------|
| 1. Efficiency of the BLDC/PMSM are greater than induction motors. Justify. | CO1 | [K ₄] |
| 2. Sketch the four quadrant operation of an electric drive and mark the torque and speed axis. | CO1 | [K ₂] |
| 3. Name any four classification of lithium ion cells based on its chemistries. | CO2 | [K ₁] |
| 4. Differentiate between a cell and battery. | CO2 | [K ₃] |
| 5. An electric vehicle fitted with 30 kwh battery pack. The motor draws average power of 6 kw to cruise 60 kmph. Compute the driving range in km by this electric vehicle. | CO3 | [K ₄] |
| 6. Compared to ICE powered vehicle transmission systems, the electric vehicle final drive transmission are smaller in size. Justify | CO3 | [K ₄] |
| 7. Determine the tractive force and power required for a 1364 kg vehicle to accelerate to 96.5 km/h in 10 seconds, assuming a constant acceleration. | CO4 | [K ₂] |
| 8. List any for simulation requirement for electric vehicle development. | CO5 | [K ₁] |
| 9. List any four advantages of fuel cell powered vehicles. | CO6 | [K ₁] |
| 10. Solar powered vehicle are said to be zero emission vehicles. Justify. | CO6 | [K ₄] |

Answer any FIVE Questions:-

PART B (5 x 16 = 80 Marks)

(Answer not more than 400 words)

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|-----|----|--|---|-----|-------------------|
| 11. | a) | Explain the construction of permanent magnet synchronous motor with its inverter circuit operations. | 8 | CO1 | [K ₂] |
| | b) | Select on your own either for DC/ AC electric drive integrated with power electronics and discuss its four quadrant operations. | 8 | CO1 | [K ₃] |
| 12. | a) | Explain the construction and operation of lithium-ion cell. And provides its charging and discharging chemical reactions. In addition , brief about the battery management systems with necessary diagrams. | 8 | CO2 | [K ₂] |
| | b) | Illustrate with necessary sketches for any two architecture of a battery electric vehicle. Also, give its advantages and disadvantages. | 8 | CO2 | [K ₃] |
| 13. | a) | Sketch the tractive effort versus speed characteristics for ICE powered and electric motor fitted drivetrain. Also, brief about the transmission (gearbox) design requirements for electric vehicle. | 8 | CO3 | [K ₆] |
| | b) | Explain the torque speed characteristics of the typical electric power train. Also, discuss about the efficiency contours in the same characteristics. Enlist the efficiency variations in the different contours with respect to torque speed characteristics. | 8 | CO3 | [K ₃] |
| 14. | a) | Explain the parallel hybrid drivetrain architecture. Also, provides its merits and demerits. | 8 | CO4 | [K ₃] |
| | b) | Discuss various types of charging the hybrid electric vehicle battery. | 8 | CO4 | [K ₃] |
| 15. | a) | A typical hybrid electric vehicle with the mass of 1364 kg has the following attributes,
(i) Aerodynamics drag coefficient 0.109, density of air 1.16 kgm ⁻³ and frontal area of 1.543 m ² .
(ii) The rolling resistance coefficient of the vehicle is 0.02.
(iii) The vehicle hilling climbing grade angle is 0.5 ⁰ .
Compute the tractive force on for the above conditions and also evaluate the tractive power at this condition when the vehicle cruise at highway with 96.5 kmph. | 8 | CO5 | [K ₅] |

- b) For a typical electric assume any two from the following, model a block diagram schematic for the design criteria. 8 CO5 [K₅]
- (i) Power electronics analysis
 - (ii) Motor performance analysis
 - (iii) Vehicle resistive force analysis\
16. a) Discuss in detail about the principle and working of a proton exchange membrane fuel cell. Also, brief with neat architecture fuel cell integrated powertrain. 8 CO6 [K₄]
- b) Illustrate the construction and working of a photovoltaic cell. And demonstrate the architecture of solar powered vehicle for battery charging at stationary conditions. 8 CO6 [K₄]
