

Duration: Three Hours

Total Marks: 80

Note:

1. Question No. 1 is compulsory
2. Solve any three questions out of remaining five questions
3. Assume suitable additional data if necessary
4. Figure on right indicates full marks

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| Q1 | a. | Explain the characteristics and performance of ultra-capacitor for EV application | 5 |
| | b. | State and explain the dynamic equation of vehicle motion | 5 |
| | c. | What is the need and importance of electric and hybrid electric vehicle | 5 |
| | d. | Enlist different modes of operation in hybrid electric vehicle technology | 5 |
| Q2 | a. | Explain the term rolling resistance and aerodynamic drag in vehicles and derive the expression for vehicle translational speed from fundamentals | 10 |
| | b. | What is z source inverter? Explain working principle using circuit diagram. Mention efficiency range of z-source inverter | 10 |
| Q3 | a. | Describe in detail all modes of operation for series hybrid vehicle | 10 |
| | b. | A series hybrid electric drive train has following design specifications | 10 |

Parameters:

Vehicle total mass = 1500 kg

Rolling resistance coefficient = 0.01

Aerodynamic drag coefficient = 0.3

Front area = 2.0 m^2

Transmission efficiency (single gear) = 0.9

Electric motor efficiency = 0.85

Vehicle mass factor, $\delta = 1.067$

Air density = 1.202 kg/m^3

Performance specifications:

Acceleration time (from 0 to 100 km/h) = $10 \pm 1 \text{ sec}$

Maximum gradeability = 30% at low speed and 5% at 100 km/h

Maximum speed = 160 km/h
 Vehicle speed corresponding to motor base speed = 50 km/h
 Final speed of vehicle = 100 km/h

Obtain the (a) traction motor size, (b) engine/generator size, and (c) power capacity of PPS

- Q4 a. Explain the two quadrant operation of chopper DC motor drive with suitable waveforms for electric vehicle 10
- b. The voltage is applied across super capacitor having capacitance of 100F is varied as follows: 10
 The potential difference is varied uniformly from 0 to 100V in 10sec.
 It is then applied then maintained at 100V for 1sec,
 then decreased uniformly to 50V in 4sec.
 Plot a graph showing the variation in the current during 15 sec of operation.
- Q5 a. Analyze the performance of BLDC and induction motors for electric and hybrid electric vehicle application 10
- b. Explain fuel cell and flywheel as energy source elements in electric and hybrid electric vehicle 10
- Q6 a. Draw and explain the typical CAN system of an hybrid electric vehicle 10
- b. Classify and explain the basic principle of Rule based energy management system. Elaborate on any one of the Rule based energy management system 10