

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

**Course Code: EE469**

**Course Name: ELECTRIC AND HYBRID VEHICLES**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 5 marks.*

Marks

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|---|---|-----|
| 1 | Which are the resistive forces that retard the motion of a four-wheel vehicle?<br>Show with a diagram.  | (5) |
| 2 | With the help of block diagram explain the major components of an electric vehicle.   | (5) |
| 3 | How the electric motors used in EVs differs from that of used in industrial application?  | (5) |
| 4 | Explain the terms specific energy and energy density as applied to batteries.   | (5) |
| 5 | With a sketch of the speed Vs. time characteristics, explain the operating regimes of a vehicle which decides the selection and sizing of its drivetrain. | (5) |
| 6 | Draw the schematic diagram of an epicyclic (planetary) gear set and show the parts.   | (5) |
| 7 | What are the important subsystems in an electric/hybrid vehicle?  | (5) |
| 8 | What is power follower strategy for energy management in hybrids? Is this a rule based strategy or an optimization based strategy?                        | (5) |

**PART B**

*Answer any two full questions, each carries 10 marks.*

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|----|--|-----|
| 9  | a) Sketch the ideal torque-speed characteristics required for an electric/hybrid vehicle power plant. Identify the regions of operation. | (4) |
|    | b) Explain the different power flow control modes of a typical parallel hybrid system with the help of block diagrams.                   | (6) |
| 10 | a) Draw six different configurations of drivetrains in electric vehicles. Briefly explain each configuration.                            | (6) |
|    | b) What are the social and environmental impacts of hybrid vehicles?   | (4) |
| 11 | a) Under what condition a pure EV can be chosen as a better option compared to hybrid vehicles considering the impact on climate change? | (4) |

- b) Differentiate between complex hybrid and series parallel hybrid configurations. (6)

### PART C

*Answer any two full questions, each carries 10 marks.*

- 12 a) Explain the forward motoring and regenerative (forward) braking control of a dc motor with a single chopper. Give circuit diagram, and show the quadrants of operation. (6)
- b) What are factors affecting the performance of batteries used in EVs? (4)
- 13 a) Give the advantages and disadvantages of fuel cells. (4)
- b) With the help of neat figures explain the general configuration of constant v/f control of induction motors. (6)
- 14 a) What are the desired features of motors used for electric vehicles? (4)
- b) What is meant by C – rating of a battery? If a 100Ah battery is rated C<sub>5</sub>, what would be its discharge current expressed as 0.5C<sub>5</sub>? (6)

### PART D

*Answer any two full questions, each carries 10 marks.*

- 15 a) Explain the terms Continuous rating, Intermittent overload operation, Peak overload operation related to electric machines used for HEV. How are these relevant to the selection/sizing of the propulsion motor in an HEV? (6)
- b) List four examples of rule based strategies that can be applied to energy management in hybrid vehicles. (4)
- 16 a) In a parallel hybrid electric vehicle (HEV) of hybrid-ness = 25%, has an electrical traction motor and an IC engine, both engine and motor shafts are inputs to a three-way transmission system with a total tractive power of 100kW. Assuming 95% efficiency, find the minimum size of battery in Ah, for a 20Hr drive cycle. Select battery voltage as 120V. (5)
- b) What is a Controller Area Network? (5)
- 17 a) What are the typical objectives a fuzzy logic based energy management control strategy addresses, and what inputs are mainly employed in the strategy? (5)
- b) Explain briefly the electrical and mechanical constraints to be considered while sizing an electrical machine for a EV. (5)

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