Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, DECEMBER 2020

SUBJECT: ELECTRIC AND HYBRID VEHICLES [AAE4021]

REVISED CREDIT SYSTEM

(30/12/2020)

Duration: 3 Hours Max. Marks: 50

Instructions to Candidates:

- **Answer all the questions**
- **Draw sketches using pencil and instruments**

1A) Define aerodynamic drag. Explain different components of aerodynamic drag and state the factors affecting the same. **(04)**

1B) With a characteristic sketch, compare the energy requirements by Internal combustion engine vehicle and the battery electric vehicle over the full speed range of the vehicles. **(03)**

1C) Determine the range of a HEV in KMs with the battery bypass mode and its fuel consumption characteristics in KM/liter with the following particulars. Consider overall efficiency of the HEV as 19%. Speed of operation: 50 KMPH, Fuel in the tank: 30 liters, Demand Power: 10 kW. **(03)**

2A) Classify HEVs based on the following parameters. (i) Power plants linked to the wheels (ii) Degree of hybridization **(03)**

2B) With a block diagram, illustrate the features of a battery with reformer fuel cell electric vehicle configuration. What are its advantages? **(04)**

2C) Illustrate how the power rating of traction motor is arrived at considering the maximum rated velocity for a proposed new electric vehicle. **(03)**

3A) Differentiate dynamic braking and regenerative braking considering a D C traction motor for the electric vehicles. Show a circuit diagram illustrating the same. **(04)**

3B) Explain how the following parameters are controlled in BLDC traction motors. **(03)**

(i) Torque variation (ii) Speed variation (iii) Switching between the motoring and generating modes.

3C) Compare series and parallel hybrid vehicle power trains based on **(03)**

(i) Size of motor required (ii) Necessity of the generator (iii) Complexity involved in transmission system design.

4A) Find the voltage output from (i) Buck converter (ii) Boost converter with the following circuit element details. Source voltage= 12 V. Turn-on time= 0.2 Second, Duty ratio= 0.6 **(03)**

4B) With a flow chart, illustrate how six different modes of operation can be set following the maximum state of charge (SOC) of the peaking power source (PPS) rule-based control strategy. **(07)**

5A) Explain with a diagram, how a four-wheel drive hybrid vehicle configuration can be realized adapting separated axle architecture. What are its advantages and disadvantages? **(04)**

5B) With a circuit diagram and overall chemical reaction, explain the working principle of a Sodium metal chloride battery. **(03)**

5C) A hybrid motor vehicle weighs 7975 N and operating in the engine alone mode. Its engine develops 14.7 kW at 2500 RPM. At this engine speed, the road speed in top gear is 64 kmph. The bottom gear reduction is 3.5:1 and the transmission efficiency is 88% in top gear and 80 % in bottom gear. The diameter of the tires is 0.76 m and the projected frontal area is 1.116 m^2. Air resistance coefficient is 0.0314 $N\text{-}hr^2/km^2\text{-}m^2$, road resistance is obtained as 0.023W, Newton. where W-weight of the vehicle in Newton. Calculate the following. **(03)**

i) Speed of the vehicle on bottom gear

ii) Tractive efforts available at the wheels on top and bottom gears

iii) Gradient which the vehicle can negotiate in bottom gear