

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

## II SEMESTER M.TECH. (AUTOMOBILE ENGINEERING) END SEMESTER EXAMINATIONS, APR 2018

SUBJECT: HYBRID AND ELECTRIC VEHICLES [AAE 5282]

## REVISED CREDIT SYSTEM (30/04/2018)

Time: 3 Hours

MAX. MARKS: 50

## Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitable assumed.
- **1A.** What are plug in Hybrid electric vehicles and how are they specified based on (03) 'electrical only' mode? What are their advantages and disadvantages?
- **1B.** Discuss essential features of any four configurations of EVs based on drive train variations. **(04)**
- **1C.** Discuss the fuel and energy saving opportunities in HEVs when compared to **(03)** Engine propelled vehicles.
- 2A. Illustrate different operating modes of I C engine dominated series- parallel (04) HEVs with power flow diagrams.
- **2B.** With a labeled diagram and characteristic, discuss the working principle of an **(04)** induction motor. List their advantages and applications.
- **2C.** Illustrate the working of IGBT as a switch. Give examples for its usage in EVs. (02)
- **3A.** What are power electronic converters? With a circuit diagram, and current **(04)** wave form, illustrate the working of a boost converter.
- **3B.** Define the following w r t traction batteries. (i) S O C (ii) Specific energy (02)
- **3C.** Explain the procedure followed while preliminarily sizing the power sources for **(04)** HEVs.
- **4A.** With a neat diagram, explain the features of a torque coupling device with two **(04)** shaft configuration. What are its advantages and disadvantages?

- 4B. An epicyclic gear train has sun and annulus gears with 28 and 56 teeth respectively. If the input speed from the engine drives the sun shaft at 3000 RPM, find (i) Number of planet gear teeth (ii) Gear ratio (iii) pinion carrier shaft (output) speed.
- **4C.** Discuss the following w r t Internal Combustion Engines.

(03)

(i) VVT-I (ii) Atkinson cycle

- **5A.** What are vehicle control systems? Explain a system strategy adapted to (03) control vehicle cruise speed.
- **5B.** For a HEV, mass of the car is 1500 kg. It has  $K_r$ = 0.01 and  $R_a$ = 0.04 AV<sup>2</sup>, where V is in kmph, Frontal area= 2.3 m<sup>2</sup>, car speed= 50 kmph in top gear with transmission efficiency as 90 %. Final drive ratio= 4.2:1. Wheel radius= 11". (04)

Find the power required for propulsion on level road and the operating speed of the engine if the HEV is run by engine alone.

5C. Check whether the Motors shown in figure 1 can start the load and get it up to the operating speed.(03)



Figure 1.