| Reg. No. | | | | | | | | | | |
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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

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**DEPARTMENT OF MECHATRONICS ENGINEERING**

**VII SEMESTER B.TECH. (MECHATRONICS ENGINEERING)**

**END SEMESTER EXAMINATIONS, DEC-2020**

**SUBJECT: HYBRID AND ELECTRIC VEHICLES [MTE 4004]**

**01-01-2021**

**Time: 3 Hours** **MAX. MARKS: 50**

**Instructions to Candidates:**

- Answer **ALL** the questions.

| Q. No | | M | CO | PO | LO | BL |
|---|---|---|---|---|---|---|
| **1A.** | Discuss various historical developments and economic analysis of vehicle technologies. | **05** | **1** | **1** | **1** | **2** |
| **1B.** | Explain maximum tractive effort and acceleration performance of vehicle. | **05** | **2** | **1** | **1** | **2** |
| **2A.** | Describe the adhesion, dynamic wheel radius and slip of vehicle. | **03** | **2** | **1** | **1** | **2** |
| **2B.** | A vehicle having large grade has the following specifications: rolling resistance coefficient=0.01, drag coefficient= 0.5, Curb Weight= 4800 N, vehicle frontal area of 1.98 $m^2$, density= 1.275 kg/m3. It's engine runs at 3500 RPM and produces 186 N-m of torque. Gear reduction ratio is 3, driveline efficiency is 88% and road wheel radius is 9 inches.<br>a) Calculate the grade and acceleration of the vehicle if the mass factor is given by $\delta = 1.04 + (0.0025)\, i^2$.<br>b) Estimate the vertical elevation with the grade calculated if the vehicle has horizontal distance covered 20m. | **04** | **2** | **2** | **1** | **3** |
| **2C.** | Elucidate why Electric Motor characteristics are more apt for EV than IC Engine | **03** | **2** | **1** | **1** | **2** |
| **3A.** | A pure EV is redesigned to extend the range of the vehicle as depicted in **Fig.3a** with the total vehicle propulsion power of 106.66 kW.<br>i) Identify the type of vehicle and estimate the power rating of the motor, peak output and intermittent output.<br>ii) If the vehicle motor has to be designed with the desired volume specification as shown in **Fig.3b**, magnetic flux density of 1.5 Tesla, 480 Ampere turns, proportional constant of 19.64, Calculate the rated speed of the Motor.<br>iii) The vehicle is designed for maximum cruising speed of 62.1371 miles per hour, gear ratio of 3.393 and vehicle tyre radius on 11.81 inches. Evaluate the maximum speed | **07** | **4** | **2**<br>**3** | **1**<br>**2** | **3** |

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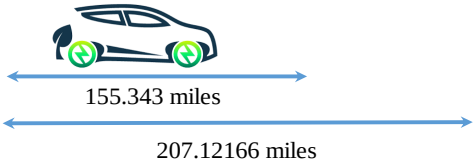
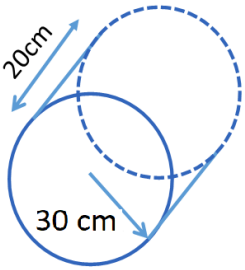
|---|---|---|---|---|---|---|
| | of the motor and recognize suitable motor, converter and voltage rating of the devices and select suitable power device for the converter ratings.<br>  <br><br>**Fig.3a**<br>  <br><br>**Fig.3b** | | | | | |
| **3B.** | Describe Hybridness in HEV and outline types of HEV vehicles using hybridness plot. | **03** | **4** | **1** | **1** | **2** |
| **4A.** | Compare various power source technologies in HEV and EV. | **05** | **4** | **1** | **1** | **2** |
| **4B.** | Outline various types of EV configurations and discuss their advantages and disadvantages. | **03** | **3** | **1** | **1** | **2** |
| **4C.** | Switched Reluctance Motor is rated power with 4kW and draws the current of 18A rated peak current. Calculate the rate of change of Inductance. | **02** | **3** | **2** | **1** | **3** |
| **5A.** | Discuss how an Induction motor can achieve EV characteristics using scalar and vector control. | **05** | **3** | **1** | **1** | **2** |
| **5B.** | Explain the power flow in series-parallel hybrid configuration. | **05** | **3** | **1** | **1** | **2** |