Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

VII SEMESTER B.TECH. (MECHATRONICS)

END SEMESTER EXAMINATIONS, NOV-2022

SUBJECT: HYBRID VEHICLE TECHNOLOGY [MTE 4072]

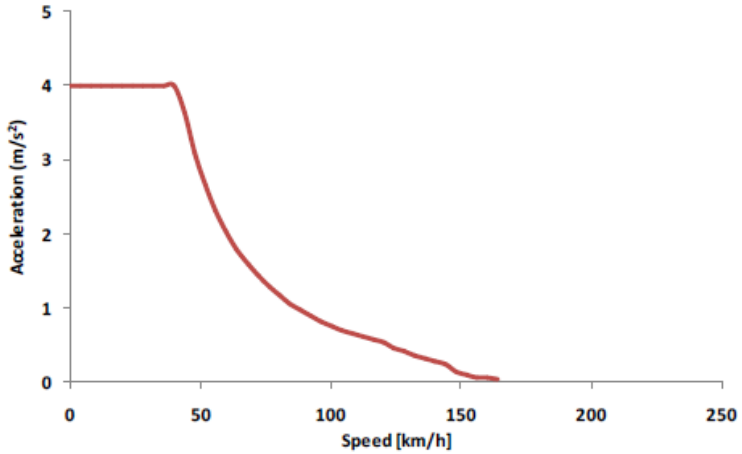
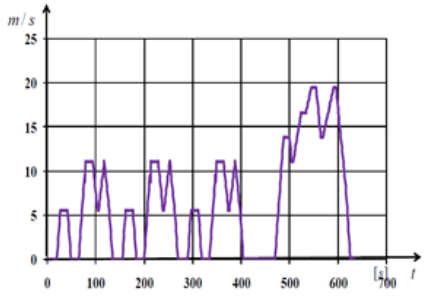
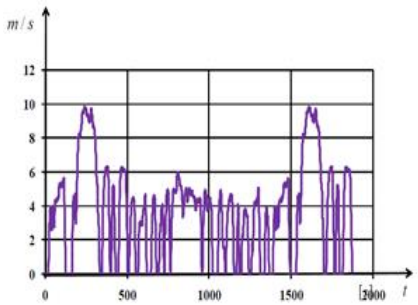
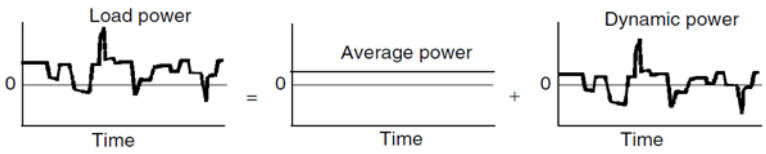
(28-11-2022)

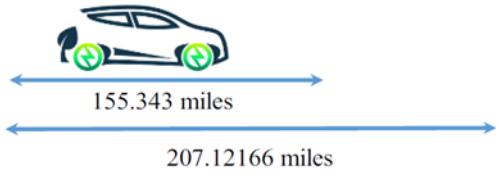
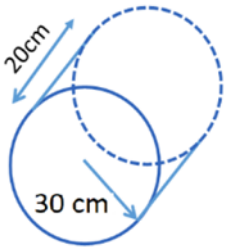
Time: 3 Hours **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.

Q. No		M	CO	PO	LO	BL
1A.	Identify the type of vehicle technology used in: a. Toyota Mirai b. Toyota Corolla c. Toyota Prius	**3**	**1**	**2**	**1**	**3**
1B.	Examine the environmental and economic aspects for the vehicles: a. Nissan Leaf b. Chevy Volt	**5**	**1**	**7**	**7**	**4**
1C.	An open convertible vehicle is cruising at a speed of 44.704 m/s. Estimate the ratio of aerodynamic force at velocity 40 kmph to the force at velocity 44.704 m/s. (Air density $\rho = 1.27$ kg/m^3).	**2**	**2**	**1**	**1**	**3**
2A.	Inspect the energy savings of Hybrid Electric Vehicles (HEV) in contrast to conventional vehicles.	**4**	**2**	**1**	**1**	**4**
2B.	Make use of characteristics to depict the types of post transmission configurations.	**3**	**2**	**1**	**1**	**3**
2C.	Compare the two hybrid configurations depicted below.  **Fig. 2C (a)**  **Fig. 2C (b)**	**3**	**2**	**2**	**1**	**4**
3A.	Estimate the tractive effort required with reference to positioning of Centre of Gravity (COG) for the data provided: Rolling resistance coefficient=0.01, Drag coefficient=0.5, Mass of Vehicle 978.592 kg, Vehicle frontal area of 1.98 m^2, Density=1.275 kg/m^3. Engine runs at 3500 RPM, Produces 186 N-m of torque. Gear reduction ratio is 3, Driveline efficiency is 88%. Road wheel radius is 9 inches. Length of vehicle is 14.7ft. Height of center of gravity is 1.64ft. Adhesive coefficient is 0.6.	**3**	**2**	**2**	**1**	**3**

3B.	Utilize the acceleration characteristics to estimate the performance factor with the vehicle rotational inertia as 1.04.  **Fig. 3B**	**2**	**2**	**2**	**1**	**3**
3C.	Examine the statement "Synchronous Reluctance Motors are promising future for EV".	**5**	**3**	**1**	**1**	**4**
4A.	Select suitable power converters and their devices necessary in a complex hybrid vehicle with justifications.	**3**	**3**	**1**	**1**	**3**
4B.	Inspect the impact of switching techniques and their switching losses in DC-AC 3ph Inverter for EV Applications.	**3**	**3**	**2**	**2**	**4**
4C.	Compare the two drive cycles shown below. Justify the importance of drive cycles in simulation of HEVs.  **Fig. 4C (a)**  **Fig. 4C (b)**	**4**	**4**	**1**	**1**	**4**
5A.	Analyze the significance of closed loop control in EV with an example.	**3**	**4**	**1**	**1**	**4**
5B.	Examine the given waveform below with a clear justification on the frequent variation of load power.  **Fig. 5B**	**3**	**5**	**1**	**1**	**4**
5C.	A pure EV is redesigned to extend the range of the vehicle as depicted in the Fig 5C(a) with the total vehicle propulsion of power 106.66kW. 1. Identify the type of vehicle and estimate the power rating of the motor, peak output and intermittent output. 2. If the vehicle motor has to be designed with the desired volume specification, as shown in Fig. 5C(b), with B=1.5T, A=240AT/m, proportional constant of 19.64, Calculate the rated speed of the motor.	**4**	**5**	**2**	**1**	**3**

	3. 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 of the motor and recognize suitable motor, converter and voltage rating of the devices and select suitable power device for the converter ratings.  **Fig 5C (a)**  **Fig 5C (b)**					