MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS
VII SEMESTER B.TECH. MECHATRONICS

END SEMESTER EXAMINATIONS, DEC. 2021

SUBJECT: HYBRID VEHICLE TECHNOLOGY [MTE 4072]

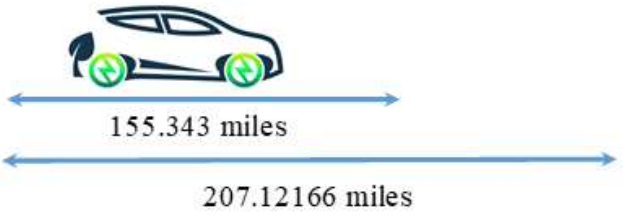
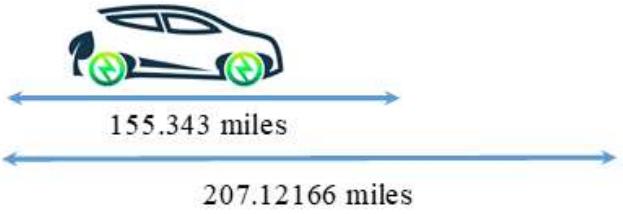
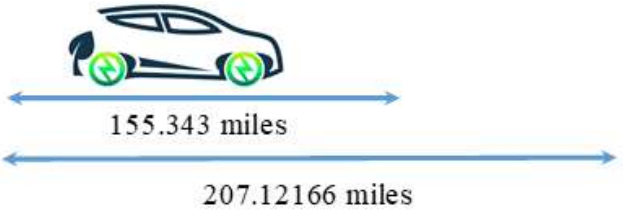
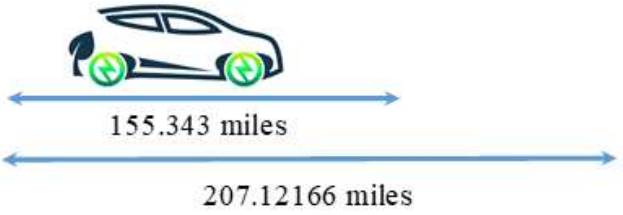
Date: 27/12/2021 **MAX. MARKS: 50**

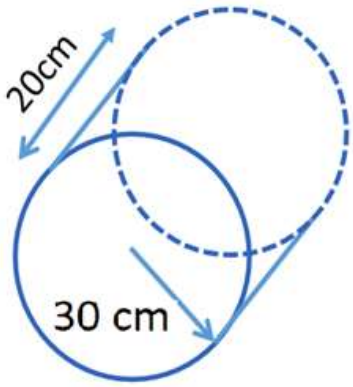
Instructions to Candidates:

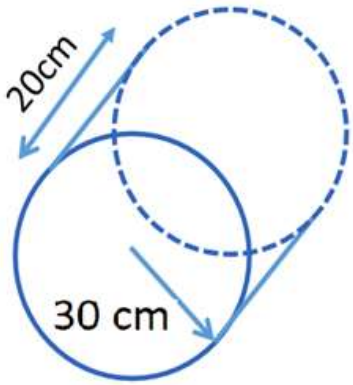
- Answer **ALL** the questions.
- Data did not provide any, may be assumed suitably.

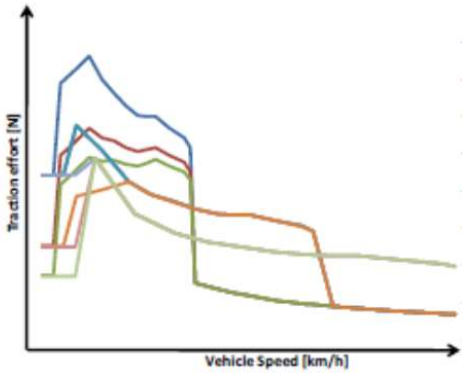
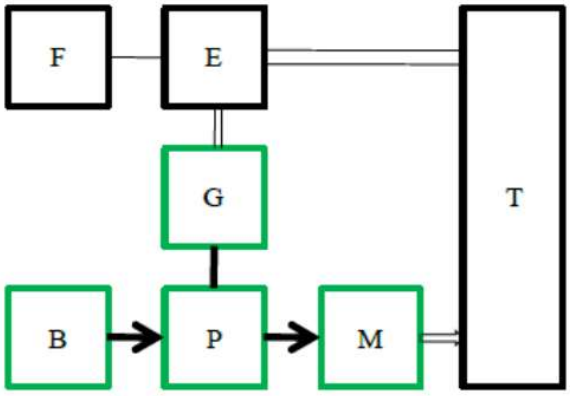
Q. No	PART – A (30×1 = 30 Marks) 50 Mins.	M	CO	PO	LO	BL
1.	Identify the type of vehicle technology used in: BMW – i3 **a. Series Hybrid** b. Parallel Hybrid c. Pure EV d. Pure EV	1	1	1	1	3
2.	Identify the type of vehicle technology used in: Toyota Mirai **a.** Series Hybrid **b.** Parallel Hybrid **c.** Pure EV **d.** Fuel Cell Based EV	1	1	1	1	3
3.	An open convertible vehicle of Mass=100kg having following coefficients (Rolling resistance coefficient = 0.01, air density = 1.27 kg/m^3, rotational inertial constant = 4%, Cd=0.6 and Af=1.9m^2). Estimate the grading and rolling resistive forces when vehicle is uphill with road angle of 10 degrees. a. 170.35N and 9.66N b. 9.66N and 170.35N c. 170.35N and 170.35N d. 9.66N and 9.66N	1	2	1	1	3
4.	An open convertible vehicle of Mass=100kg having following coefficients (Rolling resistance coefficient = 0.01, air density = 1.27 kg/m^3, rotational inertial constant = 4%, Cd=0.6 and Af=1.9m^2). Estimate the aerodynamic drag when vehicle is at 50km/hr. a. 109 N **b.** 139.64 N c. 1809.75 N d. 10.054 N	1	2	1	1	3
5.	An open convertible vehicle of Mass=100kg having following coefficients (Rolling resistance coefficient = 0.01, air density = 1.27 kg/m^3, rotational inertial constant = 4%, Cd=0.6 and Af=1.9m^2). Accelerating force when vehicle is accelerating at 7 m/s^2. a. 20 N b. 28 N	1	2	1	1	3

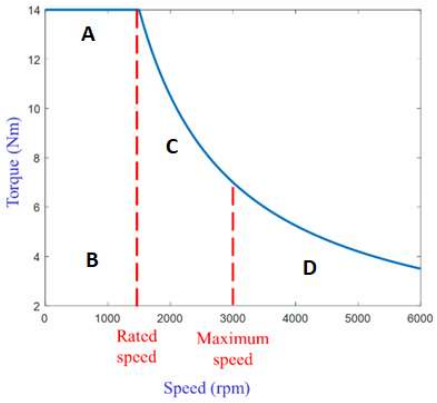
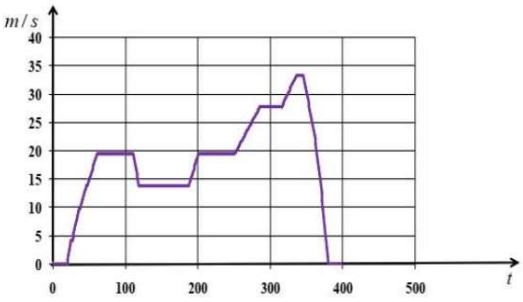
	c. 25 N d. 2800N					
6.	**A vehicle having large grade has the following specifications:** **Rolling resistance coefficient=0.01, Drag coefficient=0.5, Mass of Vehicle 489.296 kg, Vehicle frontal area of 1.98 m^2, Density=1.275 kg/m^3. Engine runs at 3500 RPM, Produces 186 N-m of torque. Gear reduction 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. Estimate the tractive effort required by front and rear wheel when Center of gravity (COG) is at mid length of vehicle from both wheels.** a. Front wheel tractive effort = 1277 N, Rear Wheel tractive effort = 1436 N b. Front wheel tractive effort = 1436 N, Rear Wheel tractive effort = 1277 N c. Front wheel tractive effort = 1356.5 N, Rear Wheel tractive effort = 1356.5 d. Front wheel tractive effort = 1277 N, Rear Wheel tractive effort = 1277 N N	**1**	**2**	**1**	**1**	**3**
7.	**A vehicle having large grade has the following specifications:** **Rolling resistance coefficient=0.01, Drag coefficient=0.5, Mass of Vehicle 489.296 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. Estimate the tractive effort required by front and rear wheel when Centre of gravity is at front wheel.** a. Front wheel tractive effort = 1277 N, Rear Wheel tractive effort = 1436 N b. Front wheel tractive effort = 2875 N, Rear Wheel tractive effort = 1.38 N c. Front wheel tractive effort = 1.38 N, Rear Wheel tractive effort = 2875 N d. Front wheel tractive effort = 0 N, Rear Wheel tractive effort = 2875 N	**1**	**2**	**1**	**1**	**3**
8.	**A vehicle having large grade has the following specifications:** **Rolling resistance coefficient=0.01, Drag coefficient=0.5, Mass of Vehicle 489.296 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. Estimate the tractive effort required by front and rear wheel when Centre of gravity is at rear wheel.** a. Front wheel tractive effort = 1277 N, Rear Wheel tractive effort = 1436 N b. Front wheel tractive effort = 2875 N, Rear Wheel tractive effort = 1.38 N c. Front wheel tractive effort = 1.38 N, Rear Wheel tractive effort = 2875 N d. Front wheel tractive effort = 2875 N, Rear Wheel tractive effort = 0 N	**1**	**2**	**1**	**1**	**3**
9.	**A pure EV is redesigned to extend the range of the vehicle as depicted in Fig with the total vehicle propulsion power of 106.66 kW.**	**1**	**5**	**1**	**1**	**3**

	Identify the type of vehicle.  **a.** PHEV **b.** EV c. Pure Hybrid d. Mild Hybrid					
10.	**A pure EV is redesigned to extend the range of the vehicle as depicted in Fig with the total vehicle propulsion power of 106.66 kW. Estimate the power rating of the motor**  **a.** 80kW b. 200kW c. 120kW d. 160kW	**1**	**5**	**1**	**1**	**3**
11.	**A pure EV is redesigned to extend the range of the vehicle as depicted in Fig with the total vehicle propulsion power of 106.66 kW. Estimate the intermittent power rating of the motor**  a. 80kW **b.** 200kW c. 120kW d. 160kW	**1**	**5**	**1**	**1**	**3**
12.	**A pure EV is redesigned to extend the range of the vehicle as depicted in Fig with the total vehicle propulsion power of 106.66 kW. Estimate the peak power rating of the motor**  	**1**	**5**	**1**	**1**	**3**

	a. 80kW b. 200kW c. 120kW d. 160kW					
13.	**Identify the Hybridness for the vehicle: Nissan Leaf** a. 0 **b.** 50 c. 75 d. 100	**1**	**5**	**1**	**1**	**3**
14.	**Identify the Hybridness for the vehicle: Maruti Swift Dezire (Petrol)** a. 0 **b.** 50 **c.** 75 d. 100	**1**	**5**	**1**	**1**	**3**
15.	**A Hybrid vehicle has Motor Rated of 80kW. If the vehicle motor has to be designed with the desired volume specification as shown in Fig, magnetic flux density of 1.5 Tesla, 480 Ampere turns, proportional constant of 19.64, Calculate the rated torque of the Motor.**  a. 510Nm **b.** 520Nm **c.** 500Nm a. 490Nm	**1**	**5**	**1**	**1**	**3**
16.	**A Hybrid vehicle has Motor Rated of 80kW. If the vehicle motor has to be designed with the desired volume specification as shown in Fig, magnetic flux density of 1.5 Tesla, 480 Ampere turns, proportional constant of 19.64, Calculate the rated speed of the Motor.**	**1**	**5**	**1**	**1**	**3**

	 **a.** 750RPM b. 1500RPM c. 3000RPM a. 6000RPM					
17.	**A Hybrid vehicle is having motor rated speed as 1500RPM. 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. Recognize suitable motor.** a. Permanent Magnet Based Motor b. Induction Based Motor c. Reluctance Based Motor d. DC Motor	**1**	**5**	**1**	**1**	**3**
18.	**For frequent changes in vehicle propulsion power distribution of Hybrid, identify the power plant suitable.** a. Diesel IC Engine b. Petrol IC Engine c. Electric Motor d. IC Engine + Electric Motor	**1**	**5**	**1**	**1**	**2**
19.	**In an IC Engine based vehicle, the aerodynamic component is of typically** a. 10% b. 5% c. 35% d. 20%	**1**	**2**	**1**	**1**	**2**
20.	**Multi Input DC-DC converters are used for** a. Hybridness of Battery and Flywheel b. Hybridness of IC Engine and Battery c. Hybridness of Battery and Supercapacitor d. Hybridness of Flywheel and supercapacitor	**1**	**3**	**1**	**1**	**2**
21.	**Identify the Motor that has good FLAT Efficiency** **a.** PMSM **b.** IM **c.** DC Motor **d.** Synch-Rel	**1**	**3**	**1**	**1**	**2**
22.	**Identify the configuration**	**1**	**2**	**1**	**1**	**3**

	 a. Configuration 1 b. Configuration 2 c. Configuration 3 d. Configuration 4					
23.	**Recognize the recent development of semiconductor devices for Electric vehicles** a. IGBT using GaN b. IGBT using Si c. MOSFET with SiC d. MOSFET with GaN	**1**	**3**	**1**	**1**	**3**
24.	**Identify the type of hybrid configuration**  a. Series b. Parallel c. Series-Parallel d. Complex	**1**	**2**	**1**	**1**	**3**
25.	**If in the Torque coupling T= k1*T1 + k2*T2, k1 = k2 =1, then identify the type of configuration** a. Configuration 1 b. Configuration 2 c. Configuration 3 d. Configuration 4	**1**	**2**	**1**	**1**	**3**
26.	**Identify the Motor and its efficient operating point**	**1**	**3**	**1**	**1**	**3**

	 a. PMSM, B **b.** PMSM, C **c.** PMSM, D **d.** IM, A					
27.	**Recognize the hybrid configuration that requires bulky motor** a. Series b. Parallel c. Series-Parallel d. Complex	**1**	**2**	**1**	**1**	**3**
28.	**Recognize the mode in general drive cycle that aids for regeneration in EV** **a.** Initial Acceleration **b.** Cruising at rated speed **c.** Cruising at max speed **d.** Retardation	**1**	**4**	**1**	**1**	**2**
29.	 **Identify the type of drive cycle** a. FTP b. EUDC c. JP d. NEDC	**1**	**4**	**1**	**1**	**3**
30.	**Function of control systems in EV/HEV is to** **a.** minimize exhaust emissions b. maximize fuel efficiency c. both minimize exhaust emissions and maximize fuel efficiency d. None	**1**	**4**	**1**	**1**	**2**

PART – B (20 MARKS)						**75 Mins.**
1A.	Compare the vehicle technologies based on economic and environmental aspects.	**3**	**1**	**1,2**	**1,2**	**4**
1B.	Examine the power flow for the hybrid configuration shown in **Fig. 1B.**  **Fig.1B**	**3**	**2**	**1,2**	**1,2**	**4**
1C.	Inspect the switching control techniques and devices used in the Kelly converter shown in **Fig. 1C.**  **Fig. 1C.**	**4**	**3**	**1,2**	**1,1 3**	**4**
2A.	Compare the performances of Permanent Magnet Synchronous Motor and Synchronous Reluctance Motor for Electric Vehicle Technology.	**3**	**3**	**1,2**	**1,2**	**4**
2B.	Examine the key role of using Drive Cycles and their types in EV controls.	**3**	**4**	**1,2**	**1,2**	**4**
2C.	Analyse types of parallel hybrid vehicles based on Hybridness.	**4**	**5**	**1,2**	**1,2**	**4**