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

DEPARTMENT OF MECHATRONICS
VII SEMESTER B.TECH. MECHATRONICS

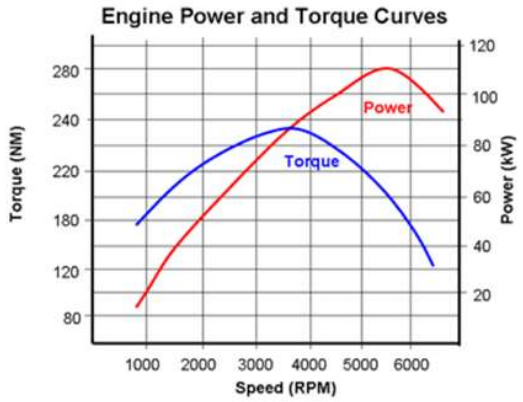
END SEMESTER EXAMINATIONS, DEC. 2021

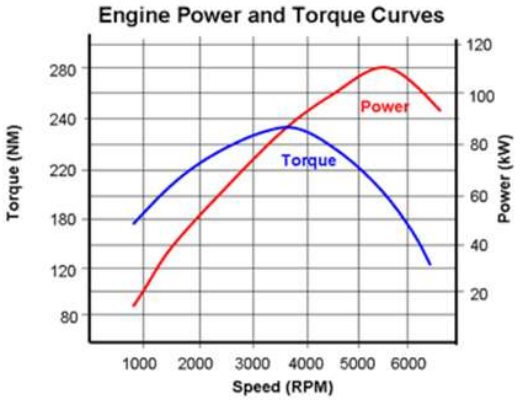
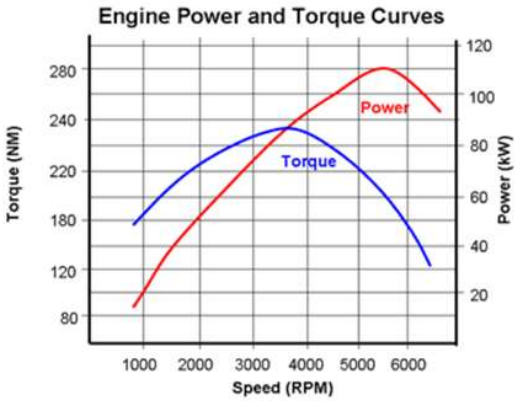
SUBJECT: MODELING OF ELECTRIC VEHICLES [MTE 4085]

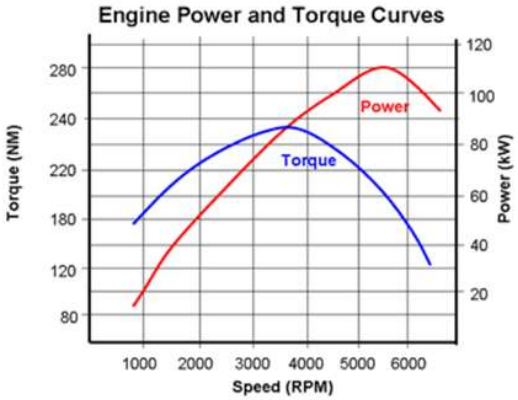
Date: 24/12/2021 **MAX. MARKS: 50**

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.	Ideal teardrop drag coefficient is **a.** 1.2 b. .39 c. .19 d. .04	1	1	1	1	2
2.	3ph, 400V, 50Hz, 4 pole Induction Motor is used for Electric Vehicle Application. The motor is controlled for constant power region using scalar control. if the motor is having voltage of 400V applied and is running at synchronous speed of 6000 RPM. Estimate the frequency of the running condition. **a.** 12.5Hz **b.** 25Hz **c.** 200Hz **d.** 50Hz	1	2	1	1	3
3.	Mahindra KUV 100 vehicle has the engine characteristics as depicted in Figure and has the gearbox specifications given in Table. Identify the maximum cruising plant speed of the vehicle  | | 1st Gear | 2nd Gear | 3rd Gear | 4th Gear | 5th Gear | | --- | --- | --- | --- | --- | --- | | Gear ratio | 3.909:1 | 2.100:1 | 1.481:1 | 1.094:1 | 0.838:1 | a. 3500RPM	1	2	1	1	3

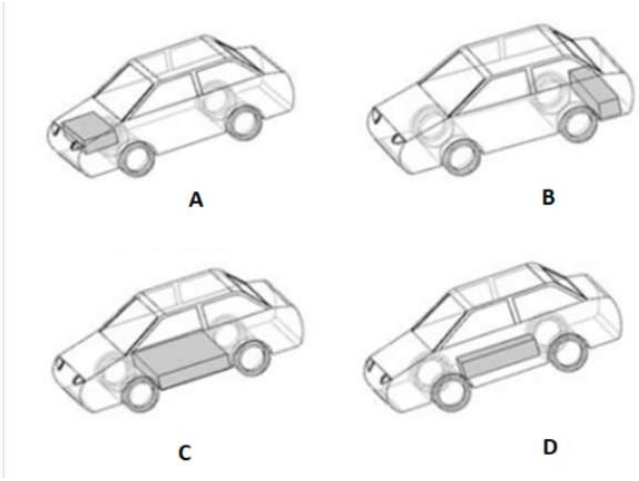
	b. 5000RPM c. 6000RPM d. 1000RPM					
4.	**Mahindra KUV 100 vehicle has the engine characteristics as depicted in Figure and has the gearbox specifications given in Table.** **Estimate the power at of the vehicle maximum torque when vehicle is in 3rd gear**  | | 1st Gear | 2nd Gear | 3rd Gear | 4th Gear | 5th Gear | | Gear ratio | 3.909:1 | 2.100:1 | 1.481:1 | 1.094:1 | 0.838:1 | **a.** 84kW b. 110kW c. 74kW d. 56kW	**1**	**2**	**1**	**1**	**3**
5.	**Mahindra KUV 100 vehicle has the engine characteristics as depicted in Figure and has the gearbox specifications given in Table.** **Calculate the value of τυ.**  | | 1st Gear | 2nd Gear | 3rd Gear | 4th Gear | 5th Gear | | Gear ratio | 3.909:1 | 2.100:1 | 1.481:1 | 1.094:1 | 0.838:1 | a. 2.395 b. 4.8 c. 1.2 d. 3.5	**1**	**2**	**1**	**1**	**3**
6.	**Mahindra KUV 100 vehicle has the engine characteristics as depicted in Figure and has the gearbox specifications given in Table.** **Identify suitable motor that can replace this IC Engine.**	**1**	**2**	**1**	**1**	**3**

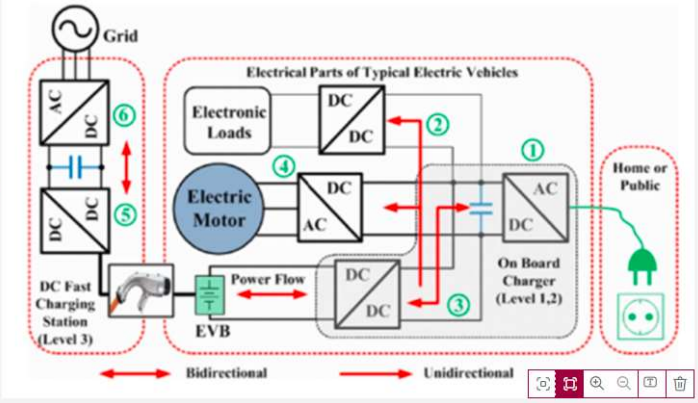
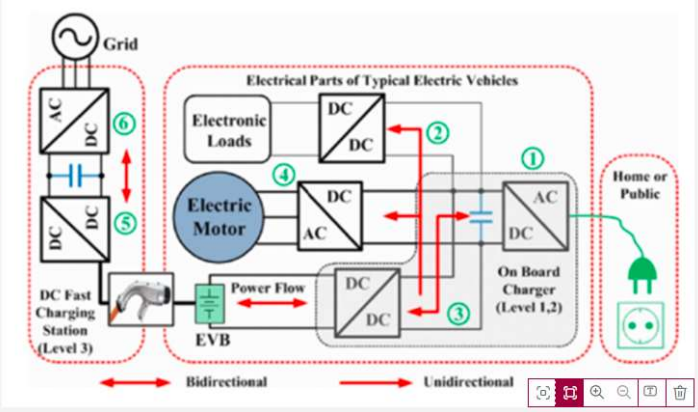


	1st Gear	2nd Gear	3rd Gear	4th Gear	5th Gear
Gear ratio	3.909:1	2.100:1	1.481:1	1.094:1	0.838:1

a. Induction Motor
b. Synchronous Motor
c. Permanent Magnet Synchronous Motor
d. Switched Reluctance Motor

7.	**Identify from the list below which of the motor can be "ideal for EV application" from its Torque-speed characteristics.** a. Induction Motor b. DC Series Motor c. PMSM d. Synchronous Motors	**1**	**2**	**1**	**1**	**3**
8.	**In case of D.C. separately excited, the constant power region for EV is achieved by keeping** a. Motor armature voltage and current rated throughout b. Motor armature voltage and field rated throughout c. Motor varying armature voltage and current rated throughout d. Motor armature voltage fixed and field current rated increasing	**1**	**2**	**1**	**1**	**2**
9.	**Generating Mode in SRM is achieved by** **a.** reversing current in the coil **b.** positive current c. negative slope of inductance d. doubling the slope of inductance	**1**	**2**	**1**	**1**	**2**
10.	**Identify the Motor Technology that does not require conventional Inverter** **a.** Induction Motor b. SRM c. PMSM d. BLDC	**1**	**2**	**1**	**1**	**3**
11.	**Recognize the fourth element of vehicle system that enhances the safety of the vehicle** **a.** Driver **b.** Environment **c.** Vehicle **d.** VDC	**1**	**3**	**1**	**1**	**3**

12.	**Which of the Motor is effected by back emf** a. Induction b. DC Motor c. PMSM d. SRM	**1**	**2**	**1**	**1**	**2**
13.	**Vector control of PMSM motor is required majorly for providing** **a.** Speed Control b. Torque control c. Current control d. velocity control	**1**	**2**	**1**	**1**	**2**
14.	**Identify the vehicle that has good COG for Battery Placement for ALL WHEEL drive Vehicle**  a. A **b.** B **c.** C d. D	**1**	**1**	**1**	**1**	**3**
15.	**TWIKE Chassis GM EV-1 technology uses** a. conventional transmission **b.** single geared transmission **c.** In wheel drive a. None	**1**	**1**	**1**	**1**	**2**
16.	**Identify the Battery Balancing Technique that is inefficient** **a.** Inductor Based b. Capacitor based c. Transformer Based a. Resistive Based	**1**	**4**	**1**	**1**	**3**
17.	**Recognize the typology for EV Application : 4**	**1**	**4**	**1**	**1**	**3**

	19.  a. Inverter without Body Diode b. Inverter with Body Diode c. Rectifier d. Chopper 4 Quadrant					
18.	**If the Motor used is SRM, then the fault tolerant topology to be used for 4 is** 19.  a. One switch per phase b. inverter c. classical two switch per phase d. rectifier	**1**	**4**	**1**	**1**	**3**
19.	**Low speed High Torque High efficiecny is key feature of which Motor drive** a. DC b. IM c. PMSM d. BLDC	**1**	**2**	**1**	**1**	**2**
20.	**When compared to Induction Motor, the synchrounous reluctance motor have drawback of** **a.** Draws high current during starting **b.** higher speed than induction motor **c.** not a self starting like induction motor **d.** produce higher torque	**1**	**2**	**1**	**1**	**2**
21.	**Recognize the vehicle having gear ratio as one** **a.** GM EV-1 TWIKE **b.** HONDA INSIGHT **c.** GM Hy-Wire	**1**	**1**	**1**	**1**	**3**

22.	**Identify the system below that requires SYNTHESIS modelling technique** a. Develop a buck converter with specification b. Input: 100V and Output: 200 volt c. Input: 100V, Output: 200 volt, DC_DC Converter Boost d. Efficiency of DC_DC Converter Boost with Input: 100V, Output: 200 volt,	**1**	**1**	**1**	**1**	**3**
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**	**5**	**1**	**1**	**3**
24.	**The product τυ is smaller indicates** a. Increase in constant power region b. increase in gears c. decrease in constant power region d. decrease in gears	**1**	**1**	**1**	**1**	**2**
25.	**Identify the Materials used for body that requires large Battery system** a. Carbon Fibre Reinforced b. Stainless steel c. Alluminium d. Glass Reinforced Plastic	**1**	**1**	**1**	**1**	**3**
26.	**Identify the cost effective Battery Balancing Technique** a. Resistive **b.** Switched inductive **c.** Switched Capacitive **d.** Switched DC-DC converters	**1**	**4**	**1**	**1**	**3**
27.	**Recognize the EV Motor company using SRM** a. Toyoto Pruis b. BMW-i3 c. Chloride Lucas d. Fiat Panda	**1**	**2**	**1**	**1**	**3**
28.	**Design consideration of any Vehicle Technology is to** **a.** A) Reduce the drag force required **b.** B) Increase the use of Battery Power drawn **c.** Both A & B **d.** None	**1**	**1**	**1**	**1**	**2**
29.	**Identify the Motor that has more rotor losses** a. Induction Motor b. Permanent Magnet Synchronous Motor c. Switched Reluctance Motor d. BLDC	**1**	**2**	**1**	**1**	**3**
30.	**Identify the Motor that is presently being used for Electric vehicles** a. Induction Motor b. PMSM	**1**	**2**	**1**	**1**	**3**

	c. BLDC d. DC Motor					
PART – B (20 MARKS)						**75 Mins.**
1A.	Analyze the impact of body chassis with material selection on resistive forces and battery power source for the following vehicles shown in **Fig 1Aa, Fig 1Ab and Fig 1Ac.**  **Fig 1Aa**  **Fig 1Ab**  **Fig 1Ac**	**5**	**1**	**1,2**	**1,2**	**4**
1B.	Compare any two modelling techniques with suitable examples.	**2**	**1**	**1,2**	**1,2**	**4**
1C.	Examine the key roles of vehicle dynamic control as fourth element.	**3**	**3**	**1**	**1**	**4**
2A.	Inspect the performances of the motor drive technologies for Electric vehicles.	**5**	**2**	**1,2**	**1,2**	**4**
2B.	Model the PMSM motor with governing equations and topologies.	**3**	**2**	**1,5**	**1,3**	**3**
2C.	Compare the active and passive cell balancing techniques.	**2**	**4**	**1**	**1**	**4**