MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
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DEPARTMENT OF MECHATRONICS

V SEMESTER B.TECH. (MECHATRONICS)

END SEMESTER EXAMINATIONS, DECEMBER 2021

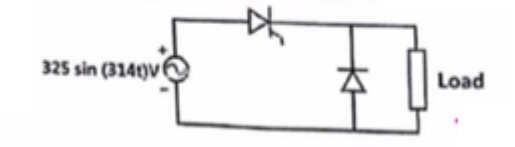
SUBJECT: ELECTRIC DRIVE [MTE 3152] – PART A

(23/12/2021)

Time: 50 minutes **MAX. MARKS: 30**

Instructions to Candidates:

- Answer **ALL** the questions.
- *Data not provided, may be suitably assumed*

Q. No		M	CO	PO	LO	BL
1	A single phase half wave rectifier is feeding a resistive load. Input voltage $v = V_m \sin \omega t$. The output dc voltage is V_{dc} and output rms voltage is V_{rms}. If firing angle is 180°, V_{dc} and V_{rms} respectively are ……. Hence zero output voltage. i. 181V, 150V ii. 109V,150V iii. 181V,109V iv. 0,0	1	2	1,3	2,3	4
2	The figure shows the circuit diagram of the rectifier. The load consists of a reactance of 10 ohms and an inductance of 0.05H connected in series. Assuming ideal thyristor and ideal diode, the thyristor firing angle (in degree) needed to obtain an average load voltage of 70V is …….  i. 69.31° ii. 65.51° iii. 62.31°	1	2	2	2	4

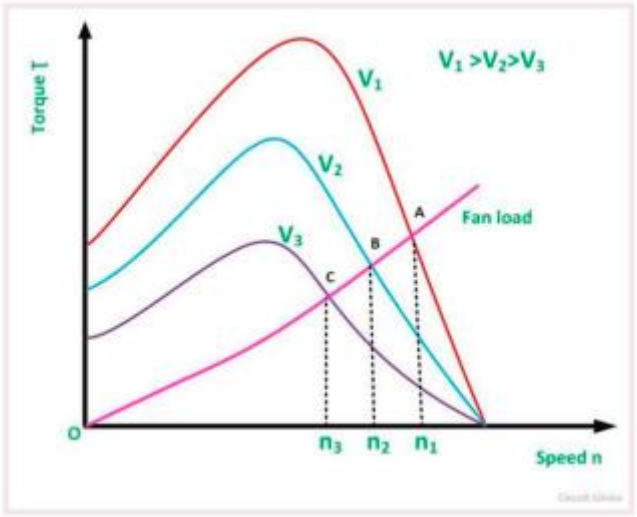
	iv. 60.91°					
3	Choose the correct statement: For full wave rectification, a four diode bridge rectifier is claimed to have the following advantages over a two diode circuit: (1) less expensive transformer (2) smaller size transformer, and (3) suitability for higher voltage application.	1	2	1	1	3
4	No-load speed of which of the ..... will be highest and the direction of rotation of a D.C. series motor can be changed by..... a) Shunt motor, interchanging supply terminals (b) Series motor, interchanging field terminals (c) Cumulative compound motor, either of (a) and (b) above (d) None of the above, Differentiate compound motor	1	3	1	1	3
5	In case of D.C. shunt motors the speed is dependent on back e.m.f. only because (a) back e.m.f. is equal to armature drop (b) armature drop is negligible (c) flux is proportional to armature current (d) flux is practically constant in D:C. shunt motors	1	3	1	2	2
6	For a 4 pole, 3 phase, 50 Hz induction motor ratio of staler to rotor turns is 2. On a certain load, its speed is observed to be 1455 r.p.m. when connected to 415 V supply. Then the value of i) The frequency of rotor e.m.f. in running condition. ii) The magnitude of induced e.m.f. in the rotor at standstill. iii) The magnitude of induced e.m.f. in the rotor under running condition. Assume star-connected stator. (i) → 2 Hz (ii) →149.8 V (iii) → 11.5 V (i) → 1.5 Hz (ii) →119.8 V (iii) → 3.594 V (i) → 1.5 Hz (ii) → 3.594 V (iii) → 119.8 V (i) → 1.5 Hz (ii) →20 V (iii) → 3.594 V	1	4	2	2,6	5
7	The speed of 500 v shunt motor is to be raised from 700 rpm to 1000 rpm by field weakening the total torque remaining unchanged, the armature and the shunt field resistance are 0.8Ω ,750 Ω	1	3	1	2	5

	respectively and the supply current at lower speed is 12 A, the additional shunt field resistance required will be a) 345 b) 354 c) 425 d) 325					
8	A 20 hp, 250 V DC shunt motor drives a load that requires a constant torque regardless the speed of operation. The armature resistance is 0.1 Ω. When this motor is running at full load, the armature current is 65 A at a speed of 1100 rpm. If the flux is reduced to 75% of its original value, the speed of the motor at this new condition will be ..... i. 1454RPM ii. 1455RPM iii. 1456RPM iv. 1457RPM	1	3	1	2	5
9	The starting torque of an induction motor is maximum when rotor resistance per phase is …… rotor reactance/phase and If Ns and N are the speeds of rotating field and rotor respectively, then ratio rotor input/rotor output is equal to..... a) Equal to, N/Ns b) Less than, Ns/N c) more than, Ns − N d) none of the above, N − Ns	1	4	1	1,2	3
10	A 20hp, 250V shunt motor with Ra=0.22 Ω, Rf=170 Ω. At no-load and rated voltage, the speed is 1200 rpm and the armature current is 3 A. At full-load and rated voltage, the line current is 55A. The full-load speed is a) 1186 b) 1146.5 c) 1256 d) 1236.5	1	3	1	1	4
11	For a single-phase dual converter, with converters C1 and C2 connected in anti-parallel, which relation among the following is true to keep the average voltages from C1 and C2 equal? C1 and C2 have firing angles α1 and α2 respectively. a. $\alpha1 = \alpha2$ b. $\alpha1 + \alpha2 = 360°$ c. $\alpha1 + \alpha2 = 180°$	1	2	1	1	3

	d. none of the mentioned					
12	During rheostat braking of DC series motors_____? a) Motor is run as a generator b) Motor is reversed in direction c) Motor is run at reduced speed	1	3	1	1	2
13	A 3-phase full-wave bridge rectifier is required to fed a 150Ω resistive load from a 3-phase 127 volt, 60Hz delta connected supply. Ignoring the voltage drops across the diodes, calculate: 1. the DC output voltage of the rectifier and 2. the load current. i. 171.5V, 1.14A ii. 1705V, 1.14A iii. 175V, 0.1A iv. 170V, 0.1A	1	2	2	1,2	4
14	The single-phase half-wave controlled rectifier supplies a resistive load draws an average current of 1.99 A. If the converter is operated from a 350 V, 60 Hz supply and if the average value of the output voltage is 8V, the calculated rms load voltage and DC power are. i. 34.21V, 15.92W ii. 35.21V, 15.92W iii. 34.21V, 15W iv. 35.21V, 15W	1	2	2	1,2	4
15	A single-phase full-bridge voltage source inverter (VSI) is fed from a 300 V battery. A pulse of 120º duration is used to trigger the appropriate devices in each half-cycle. Estimated rms value of the fundamental component of the output voltage, in volts is….. i. 234V ii. 236V iii. 231V iv. 230V	1	2	1	1,2	5
16	In a bridge full wave rectifier, the input sine wave is 40sin100 πt. The average output voltage is ___ 1. 22.73V 2. 16.93V 3. 25.47V 4. 33.23V	1	2	1	1	2
17	A 220 V d.c series motor has armature and field resistances of 0.10 Ω and 0.90 Ω respectively. It takes a current of 20 A from the supply while running at 1000 rpm. If an external resistance of 1 Ω is inserted in series with the motor, The new speed calculated is…….. . Assume the load torque remains constant. i. 857	1	3	1	1	3

	ii. 858.8 iii. 878.8 iv. 868.8					
18	If the firing angle becomes negative, then the rectifier begins to work as 1. A rectifier 2. An inverter 3. A chopper 4. A regulator	1	2	1	1	2
19	A 3-phase, 6 pole induction motor is rated 400Hz, 150V, 10hp, 3% slip at rated power output. The windage and friction loss is 200W at rated speed. With the motor operating at rated voltage, frequency, slip, and output power. Determine the Rotor speed. 1. 7760rpm 2. 7770rpm 3. 7000rpm 4. 7660rpm	1	4	2	1	4
20	A 3-phase, 6 pole induction motor is rated 400Hz, 150V, 10hp, 3% slip at rated power output. The windage and friction loss is 200W at rated speed. With the motor operating at rated voltage, frequency, slip, and output power. Determine the Frequency of the rotor current. 1. 12hz 2. 10 hz 3. 11 hz 4. 15 hz	1	4	1,2	1	4
21	A 3-phase, 6 pole induction motor is rated 400Hz, 150V, 10hp, 3% slip at rated power output. The windage and friction loss is 200W at rated speed. With the motor operating at rated voltage, frequency, slip, and output power. Determine the power crossing the air gap. 1. 7896.9W 2. 7886.9W 3. 7876.9W 4. 7866.9W	1	4	1,2	1	4
22	A 3-phase, 6 pole induction motor is rated 400Hz, 150V, 10hp, 3% slip at rated power output. The windage and friction loss is 200W at rated speed. With the motor operating at rated voltage, frequency, slip, and output power. Determine the Rotor copper loss. 1. 236.9W 2. 286.9W	1	4	2	1	4

	3. 266.9W 4. 276.9W					
23	A 3-phase, 6 pole induction motor is rated 400Hz, 150V, 10hp, 3% slip at rated power output. The windage and friction loss is 200W at rated speed. With the motor operating at rated voltage, frequency, slip, and output power. Determine the Output torque 1. 8.28Nm 2. 99.28Nm 3. 9.28Nm 4. 9.0Nm	1	4	2	1	4
24	No-load speed of which of the ..... will be highest and the direction of rotation of a D.C. series motor can be changed by..... 1. Shunt motor, interchanging supply terminals 2. Series motor, interchanging field terminals 3. Cumulative compound motor, either of (1) and (2) above 4. None of the above, Differentiate compound motor	1	4	1	1	2
25	The DC motor that can provide zero speed regulation at full load without any controller is …….. a) Series b) Shunt c) Differential compound d) Cumulative compound	1	3	1	1	2
26	A half-controlled single-phase bridge rectifier is supplying an R-L load. It is operated at a firing angle α and the load current is continuous. The fraction of cycle that the freewheeling diode conducts is a) ½ b) $(1-\frac{\alpha}{\pi})$ c) $\frac{\alpha}{2\pi}$ d) $\frac{\alpha}{\pi}$	1	2	1	1	3
27	Choose the correct statement a) MOSEFT is majority carrier devices, whereas IGBT, Diode, Thyristor are minority carrier devices.	1	2	1	1	2

	b) MOSEFT, IGBT, Diode, Thyristor are majority carrier devices. c) MOSEFT is minority carrier devices, whereas IGBT, Diode, Thyristor are majority carrier devices. d) MOSEFT and Thyristor are majority carrier devices where as IGBT and Diode are minority carrier devices.					
28	A phase-controlled, single-phase, full-bridge converter is supplying a highly inductive DC load. The converter is fed from a 230 V, 50 Hz, AC source. The fundamental frequency in Hz of the voltage ripple on the DC side is a) 25 b) 50 c) 100 d) 300	1	5	1	1	2
29	For full wave rectifier, a four diode bridge is claimed to have following advantage. 1. Less expensive transformer 2. Less voltage stress 3. Suitability for lower voltage application 4. Smaller size transformer	1	2	1	1	2
30	A three phase, 4 pole, 400V line to line, 50Hz induction motor is used for fan load as shown in figure. Identify the stability at point A, B, C.  1. A is stable, B is stable, C is unstable	1	1	1	1	3

	2. A is unstable, B is unstable, C is unstable 3. A is stable, B is unstable, C is stable 4. A is stable, B is stable, C is stable					

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DEPARTMENT OF MECHATRONICS

V SEMESTER B.TECH. (MECHATRONICS)

END SEMESTER EXAMINATIONS, DECEMBER 2021

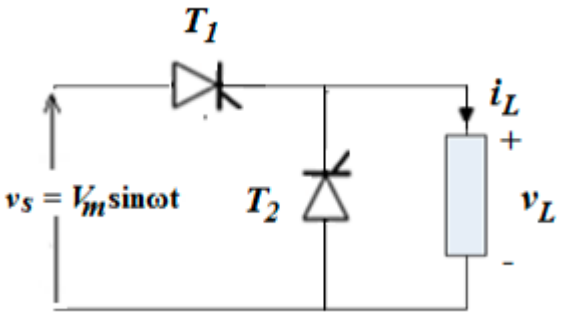
SUBJECT: ELECTRIC VEHICLE [MTE 3152] – PART B

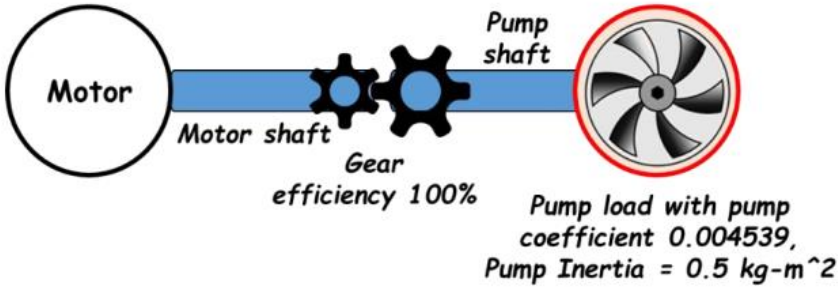
(23/12/2021)

Time: 75+10 minutes **MAX. MARKS: 20**

Instructions to Candidates:

- Answer **ALL** the questions.
- *Data not provided, may be suitably assumed*

Q. No		M	CO	PO	LO	BL
1A.	For the single-phase half-wave controlled rectifier shown in Fig.1.A, thyristor T1 is operating at α1 = 80º. Thyristor T2 is connected across the load and operating with a delay angle α2 of 40º. Assume the load is highly inductive such that IL is continuous. Plot waveforms for the instantaneous values of V_L, I_{T1}, I_{T2}, IL, V_{T1} and V_{T2}. Derive an expression for the average load voltage Vdc as a function of α1 and α2 (with α1 < α2).  Fig.1.A	**4**	**2**	**2**	**2**	**3,4**
1B.	A 2.2kW, 1500RPM DC series motor draws the rated load current of 11A. The motor is loaded with the following duties. i. With a load of 10A for 5 secs ii. Without load for 5 secs. iii. With load torque 7Nm for 3secs iv. With full load for 3secs. Estimate the equivalent current and the power of the motor drive and plot the temperature rise graph.	**3**	**1**	**2**	**2**	**3**

1C.	Identify and elaborate on the components of complete closed loop Electric Vehicle Drive system.	**3**	**1**	**1**	**1**	**3**
2A.	Choose suitable Motors for following Applications. Elaborate a) Position control. b) Cost effective and High Efficient Industrial Applications. c) Power Generation.	**3**	**5**	**1,2**	**13**	**3**
2B.	In a synchronous motor the magnetic Field in the rotor is steady (apart from the brief periods when the load or excitation changes), so there will be no danger of eddy currents. Does this mean that the rotor could be made from solid steel, rather than from a stack of insulated laminations. Explain	**4**	**4**	**1**	**1**	**4**
2C.	A motor is used to drive a centrifugal pump through a gear reduction by two as depicted in Fig 2.C. If the motor has internal load and inertia as 5Nm and 0.1 kg-m^2, construct the equivalent torque and kinetic energy stored due to inertia when the pump has efficiency of 80% and running at 750rpm.  Fig.2.C	**3**	**1**	**2**	**2**	**3**