Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

V SEMESTER B.TECH. MECHATRONICS

END SEMESTER EXAMINATIONS, NOV-DEC. 2023

SUBJECT: ELECTRIC DRIVES SUBJECT CODE: MTE 3152

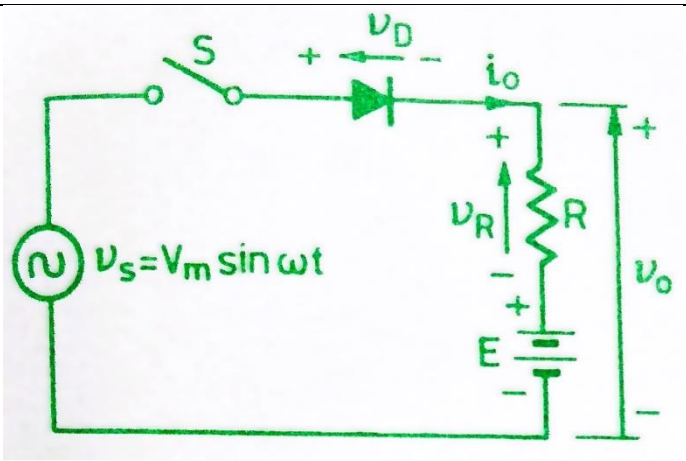
(Date:09/01/2024)

Time: 3 Hrs **Max. Marks: 50**

Instructions to Candidates: Answer all questions.

Missing data may be suitably assumed and justified.

Q. No	Problem Statement	M	CO	PO	LO	BL
1A	Design a simple unipolar drive circuit with an electrical time constant of 2 msec at phase on and 1 msec at phase off. The pace of stepping is 300 steps per second. Specification given for robotics application, a 3-Φ variable reluctance stepper motor has the following parameters: $R_W = 1\Omega$, $L_W = 30mH$(average phase winding inductance), I = 3A (rated winding current).	**4**	**5**	**3**	**5**	**6**
1B	A stepper motor has a step angle of 2.5°. Determine (a) resolution, (b) number of steps required for the shaft to make 25 revolutions and (c) shaft speed, if the stepping frequency is 3600 rps.	**3**	**5**	**1**	**1**	**3**
1C	A 3-Φ, 460V, 15hp, 50Hz, four-pole, 1728 rpm induction machine delivers full output power to a load connected to its shaft. The windage and friction loss of the motor is 750W. Estimate the: (a) Mechanical power developed, (b) Air gap power.	**3**	**4**	**1**	**1**	**3**
2A	A 3-Φ, 460V, 100hp, 50Hz, four-pole induction machine delivers rated output power at a slip of 0.05. Compute the: (a) synchronous speed and motor speed, (b) speed of rotating air gap field, (c) frequency of the rotor circuit, (d) slip in rpm, (e) rotor induced voltage at the operating speed if the stator-to-rotor turn ratio is 1:0.5.	**4**	**4**	**1**	**1**	**3**
2B	A step up chopper used for regenerative braking for motor load has input voltage of 220 V and output voltage of 660 V. If the conducting time of thyristor –chopper is 100 μs, compute the pulse width of output voltage. In case output-voltage pulse width is halved for constant frequency operation, find the average value of new output voltage.	**3**	**4**	**1**	**1**	**3**
2C	A single phase bridge type cycloconverter has input voltage 230 V, 50 Hz and load of R = 10 Ω, Output frequency is one third of input frequency. For a firing angle delay of 30°, calculate: (a) rms value of output voltage (b)rms current of each converter (c) rms current of each thyristor.	**3**	**4**	**1**	**1**	**3**
3A	A dc battery of constant emf 'E' is being charged through a resistor as shown in the Fig.1. For source voltage of 230V, 50Hz and for R= 10 Ω, E=120 V.	**5**	**2**	**1**	**1**	**3**

	 Fig Q3.a Single-phase half-wave diode rectifier with RE load Estimate: (a) the value of average charging current, (b) the power supplied to battery and dissipated in the resistor, (c) supply power factor, (d) the charging time in case battery capacity is 1100Wh, and rectifier efficiency and PIV of the diode.					
3B	Determine the developed torque and shaft torque of 220V, 4-pole series motor with 800 conductors wave-connected supplying a load of 8.2 kW by taking 45A from the mains. The flux per pole is 25mW and its armature circuit resistance is 0.6Ω.	**3**	**3**	**1**	**1**	**3**
3C	A 220V dc shunt motor runs at 500 r.p.m. when the armature current is 50A. Calculate the speed if the torque is doubled. Given that R_a = 0.2 Ω.	**2**	**3**	**1**	**1**	**3**
4A	A single-phase transformer, with secondary voltage of 230 V, 50Hz, delivers to load R=20 Ω through a half-wave, controlled rectifier circuit. For a firing angle delay of 45°, estimate (a) the rectification efficiency, (b) form factor, (c) voltage ripple factor, (d) transformer utilization factor and (e) PIV of thyristor.	**4**	**2**	**1**	**1**	**3**
4B	The gate-cathode features of an SCR have a straight-line slope of 130. Calculate the gate-source resistance with a trigger voltage of 15V and a permitted gate power dissipation of 0.5watts.	**4**	**2**	**1**	**1**	**3**
4C	A type-A chopper used in control of DC motor drive has input dc voltage of 200 V and a load of R = 10 Ω in series with L = 80 mH. If the load current varies linearly between 12 A and 16 A, find the time ratio T_{on}/T_{off} for this chopper.	**2**	**4**	**1**	**1**	**3**
5A	Examine the four-quadrant operation of motor drives for electric vehicle.	**4**	**1**	**1,2**	**1,2**	**4**
5B	An electric motor has a heating time constant of 60 min and cooling time constant of 90 min. When run continuously on full load of 40 kW, the final temperature rise is 50°C. Determine the amount of load motor handle for 20 minutes if it is followed by shut down for a long time so that it can cool down. Determine the maximum value of the load it can supply if it is on an intermittent load for 20 minutes and then shut down for 20 minutes.	**3**	**1**	**1**	**1**	**3**
5C	For an SCR, the gate-cathode characteristics has a straight-line slope of 130. For trigger voltage of 15V and allowed gate power dissipation of 0.5watts, compute the gate-source resistance.	**3**	**2**	**1**	**1**	**3**