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

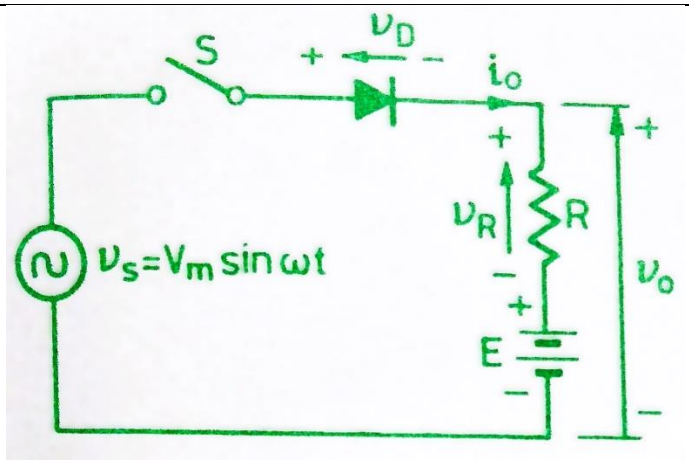
(Date: 04/12/2023)

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	Examine the four-quadrant operation of motor drives in electric vehicle technology.	**4**	**1**	**1,2**	**1,2**	**4**
1B	A motor has a heating time constant of 50 min and cooling time constant of 80 min. When run continuously on full load of 30 kW, the final temperature rise is 50°C. Determine the amount of load motor handle for 10 minutes if it is followed by shut down for a long time so that it can cool down. Estimate the maximum value of the load it can supply if it is on an intermittent load for 10 minutes and then shut down for 10 minutes.	**3**	**1**	**1**	**1**	**3**
1C	A single phase 230 V, 1kW heater is connected across single phase 230 V, 50 Hz supply through a diode. Calculate the power delivered to the heater element. Find also the peak diode current and input power factor.	**3**	**2**	**1**	**1**	**3**
2A	A single-phase transformer, with secondary voltage of 230V, 50Hz, delivers to load R=10Ω through a half-wave, controlled rectifier circuit. For a firing angle delay of 60°, compute (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**
2B	A single phase 230 V, 1kW heater is connected across single phase 230 V, 50 Hz supply through an SCR. For firing angle delays of 45° and 90°, calculate the power absorbed in the heater element.	**4**	**2**	**1**	**1**	**3**
2C	Justify the statement "induction motor runs in asynchronous speed".	**2**	**4**	**1,2**	**1,2**	**4**
3A	A dc battery of constant emf E is being charged through a resistor as shown in Fig 3a. For source voltage of 230V, 50Hz and for R= 8 Ω, E=150 V. 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 1000Wh, and rectifier efficiency and PIV of the diode.	**5**	**2**	**1**	**1**	**3**

	 Fig Q3.a Single-phase half-wave diode rectifier with RE load					
3B	A 220V dc series motor has armature and field resistances of 0.2Ω and 0.5Ω respectively. When running at 1000 rpm the motor draws 10A from the supply. Calculate the torque delivered.	**3**	**3**	**1**	**1**	**3**
3C	A shunt machine develops an ac e.m.f. of 250V at 1500 r.p.m. Determine its torque and mechanical power developed for an armature current of 50A. State the simplifying assumptions.	**2**	**3**	**1**	**1**	**3**
4A	A 208 V, 10hp, four pole, 50 Hz, Y-connected induction motor has a full-load slip of 5%. Evaluate: (a) synchronous speed of this motor, (b) rotor speed of this motor at rated load, (c) rotor frequency of this motor at rated load, (d) shaft torque of this motor at rated load.	**4**	**4**	**1**	**1**	**3**
4B	Inspect the effect of slip on rotor frequency of induction motor with suitable expressions.	**3**	**4**	**1,2**	**1,2**	**4**
4C	A 220 V, 3-Φ, two pole, 50 Hz induction motor is running has at a slip of 5%. Compute: (a) speed of magnetic fields in revolutions per minute, (b) speed of rotor in revolutions per minute, (c) slip speed of the rotor, (d) rotor frequency.	**3**	**4**	**1**	**1**	**3**
5A	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). Design a simple unipolar drive circuit such that the electrical time constant is 2 msec at phase turn on and 1 msec at phase turnoff. The stepping rate is 300 steps per second.	**4**	**5**	**3**	**5**	**6**
5B	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**
5C	A 240 V, 3-Φ, four pole, 50 Hz induction motor is running has at a slip of 4%. Estimate: (a) speed of magnetic fields in revolutions per minute, (b) speed of rotor in revolutions per minute, (c) slip speed of the rotor, (d) rotor frequency.	**3**	**4**	**1**	**1**	**3**