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**MANIPAL INSTITUTE OF TECHNOLOGY** 

MANIPAL (A constituent unit of MAHE, Manipal)

# DEPARTMENT OF MECHATRONICS V SEMESTER B.TECH. (MECHATRONICS)

### END SEMESTER MAKE-UP EXAMINATION, DEC-2022-JAN-2023

SUBJECT: ELECTRIC DRIVES

## SUBJECT CODE: MTE 3152

#### (Date: 02/01/2023)

#### Time: 180 Minutes

#### Max. Marks: 50

Instructions to Candidates: All questions are compulsory.

Missing data may be suitably assumed and justified.

Q. No		Μ	CO	PO	LO	BL
1(A).	Examine the types of induction motors and their operating principles. Provide a suitable diagram to support the answer.	5	CO4	2	2	4
1(B).	A single phase bridge type cycloconverter has input voltage 230 V, 50 Hz and load of R = 20 $\Omega$ , Output frequency is one- fifth of input frequency. For a firing angle delay of 45°, calculate (a) rms value of output voltage (b) rms current of each converter (c) rms current of each thyristor and (d) input power factor.	3	CO2	1	1	3
1(C).	A buck converter used in various electrical vehicles has input voltage of 18 V. The duty ratio is 0.4 and frequency is 25 kHz. The inductance L=200 $\mu$ H and filter capacitance C=400 $\mu$ F. Average load current is 2 A. Estimate: (a) average output voltage, (b) peak to peak inductor current and capacitor voltage (c) maximum switch voltage.	2	CO2	1	1	3
2(A).	A 208-V, 10hp, 4-pole, 60 Hz, Y-connected induction motor has a full-load slip of 5 percent. 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	CO4	1	1	3
2(B).	A 2.2 kW motor with torque to ampere ratio of 1.27 Nm/A is loaded with following duties for following durations supplied with applied peak voltage of AC 1-ph 325 V and running with rated speed of 1500 rpm, (a) With a load of 10 A for 5 secs, (b) Without load for 5 secs,(c) With load torque 7 Nm for 3 secs and (d) With full load for 3 secs. Calculate the equivalent torque.	3	CO1	1	1	3
2(C).	Distinguish the DC and AC servo motors used in industrial applications.	3	CO5	2	2	4
3(A).	A d.c. generator has an armature e.m.f of 200 V when the useful flux per pole is 30 mWb and the speed is 900 r.p.m. Determine the generated e.m.f. (a) with the same flux and a speed of 1100 r.p.m., (b) with a flux per pole of 34 mWb and a speed of 1000 r.p.m.	4	CO3	1	1	3
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<b>3(B).</b>	Analyze the DC motor's design and operation. Describe the response using a clear drawing.	4	CO3	1	1	4
3(C).	When driven at speed of 200 RPM with flux per pole of 0.03 Wb, a DC generator has an EMF of 300 V. If the speed is increased by 11 RPM and at the same time, flux is reduced to 0.029 Wb, then estimate the value of induced emf.	2	CO3	1	1	3
4(A).	Give a thorough classification of the various stepper motor types based on their uses and operating principles.	4	CO5	2	2	4
4(B).	For use in electric vehicle applications, BLDC motors are preferred to PMDC motors. Give your views in support of the response. Justify the BLDC motor's specifics.	3	CO5	2	2	4
4(C).	The armature of a 6 pole DC Generator has 650 wave winded conductors. Calculate the generated EMF when the flux per pole is 0.055 Wb and speed of the generator is 300 RPM. Also, determine the speed at which armature must be driven to generate an EMF of 550 V if the flux is reduced to 0.05 Wb.	3	CO3	1	1	3
5(A).	A hybrid variable reluctance stepping motor has 8 main poles which have been castleated to have 5 teeth each. If it has 50 teeth, determine the steeping angle. A stepper motor has a step angle of 3.5°. Calculate (a) resolution, (b) number of steps required for the shaft to make 30 revolutions and (c) shaft speed, if the stepping frequency is 3500 rps.	4	CO4	1	1	3
5(B).	A 3-phase, 6-pole, 50 Hz induction motor has a slip of 2% at no load and 4% at full load. Determine: (a) synchronous speed; (b) no load speed; (c) full load speed; (d) frequency of rotor current at standstill; (e) frequency of rotor current at full load.	4	CO4	1	1	3
5(C).	Examine the key components of a DC machine in the context of an industrial application.	2	CO3	2	2	4