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MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

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

END SEMESTER EXAMINATION, NOVEMBER 2022

SUBJECT: ELECTRIC DRIVES

SUBJECT CODE: MTE 3152

(Date: 26/11/2022)

Time: 180 Minutes

Max. Marks: 50

Instructions to Candidates: All questions are compulsory.

Missing data may be suitably assumed and justified.

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1(A).	Examine the working principle of induction motor with its types. Support the answer with appropriate diagram.	5	CO4	1	2	4
1(B).	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 and (d) input power factor.	3	CO2	1	1	3
1(C).	A boost converter used in a hybrid electrical vehicle has input voltage of 20V, and output voltage of 50 V. The switching frequency is 25 kHz. The inductance L=200 μ H and load resistance R= 20 Ω and filter capacitance C=400 μ F. Estimate: (a) duty ratio, (b) average value of input and output currents, (c) inductor peak to peak ripple current (d) minimum and maximum values of inductor current.	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 variable speed d.c drive has rated power of 10 kW, rated speed of 1500 rpm drives a load that comprises a constant load of $T_L = 30$ Nm. The inertia of the drive system is 0.10 kg.m ² . Estimate the time taken to accelerate the load from zero to 800 rpm, assuming the drive develops rated torque during the acceleration phase.	3	CO1	1	1	3
2(C).	BLDC motor is preferred over PMDC for electric vehicle application. Support the answer with your opinion. Justify the details about the BLDC motor.	3	CO5	1	2	4
3 (A).	Examine the construction and working of DC Motor. Justify the answer with neat sketch.	4	CO3	1	1	4

3(B).	A d.c. generator has an armature e.m.f of 100 V when the useful flux per pole is 20 mWb and the speed is 800 r.p.m. Determine the generated e.m.f. (a) with the same flux and a speed of 1000 r.p.m., (b) with a flux per pole of 24 mWb and a speed of 900 r.p.m.	4	CO3	1	1	3
3(C).	Inspect the important features of DC Machine in context of industrial application.	2	CO3	1	2	4
4(A).	Classify types of stepper motor in details based on working principle and its application. Provide a comparison between variable reluctance stepper motor and switched reluctance motor.	4	CO5	1	2	4
4(B).	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
4(C).	Examine the different servo motor used in various industrial applications.	3	CO5	1	2	4
5(A).	A 3-phase, 6-pole, 50 Hz induction motor has a slip of 1% at no load and 3% 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(B).	Differentiate between the characteristics of a transformer and an induction motor used in heavy industries. 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.	4	CO4	1	1	3
5(C).	When driven at speed of 100 RPM with flux per pole of 0.02 Wb, a DC generator has an EMF of 200 V. If the speed is increased by 11 RPM and at the same time, flux is reduced to 0.019 Wb, then estimate the value of induced emf.	2	CO3	1	1	3