Reg. No.



## **IV SEMESTER B.TECH. (ELECTRICAL & ELECTRONICS ENGINEERING)**

## **END SEMESTER EXAMINATIONS, May 2023**

## **ELECTRICAL MACHINERY-II [ELE 2251]**

REVISED CREDIT SYSTEM		
Time: 3 l	Hours 31 MAY 2023	Max. Marks: 50
Instructio	ons to Candidates: Answer ALL the questions.	
**	missing data may be suitably assumed.	
1A.	An electric motor manufacturer, XYZ India Ltd., manufactured a 220V DC shunt motor-generator set for a constant speed application. The efficiency of this set is to be determined by cond a suitable test.	10 HP, drive lucting
	Which of the following tests would you recommend? Justify your a with the circuit diagram and procedure to be followed.	answer
	a. Sumpner's test b. Hopkinson's test	
	c. Field's test d. Retardation test	(04)
1B.	A voltage of 230 V is measured across the armature of an 8.8 k series motor which is used in a construction site. The motor is su with 250V DC. The resistance of the armature circuit and the field are 0.3 $\Omega$ and 0.2 $\Omega$ respectively.	W DC pplied circuit
	Is the motor capable of working at more than 85% efficiency at the load condition?	e rated
	(Assume constant losses to be $50\%$ of the copper losses at current).	rated <b>(03)</b>
1C.	Determine the distribution factor corresponding to the fifth har component of generated voltage in a three-phase, 50 Hz, AC gen with 54 slots & 6 poles.	rmonic lerator
	Also, comment on the effects of the fifth harmonic component generated voltage.	in the <b>(03)</b>
2A.	Assume a purely resistive load connected across the terminals alternator. Will the voltage regulation of the alternator be zero? your answer.	of an Justify <b>(02)</b>
2B.	Consider a 3-phase, 8 pole, 50 Hz, star-connected alternator average flux in the machine is 40 mWb /pole. The armature has 7 with 10 conductors in each slot. Calculate the induced voltage per The coils are short-pitched by 2 slots.	r. The 2 slots phase. <b>(04)</b>

A 1,000 kW, 3.3 kV, 24 poles, 50Hz, 3-phase star-connected 2C. synchronous motor has a synchronous reactance of 3.4  $\Omega$  per phase and the resistance is negligible. The motor is fed from an infinite bus bar at 3.3kV. Its field excitation is adjusted to result in upf operation at rated load.

At this excitation, estimate the maximum power and torque this motor can deliver. Explain with the help of power-angle characteristics.

3A. Compare the steady state mathematical model of salient-pole rotor & non-salient-pole rotor alternators with the help of phasor diagrams relating the induced voltage and terminal voltages.

Also, suggest suitable methods to determine the reactance of these machines.

- 3B. Write a technical note on hunting in synchronous motors and how it can be mitigated.
- 3C. A 3-phase cylindrical rotor alternator operating in a captive plant has a rating of 80 kVA, 440 V. This alternator is supplying power to a drive system at a rated current and 0.75 lagging power factor. Consider an armature resistance of 0.25 ohm per phase and a synchronous reactance of 3.2 ohms per phase. Determine the voltage regulation.
- 4A. V' and 'inverted V' curves have significant importance in analyzing the behaviors of synchronous machines.

Justify this statement suitably.

- **4B**. A 5 MVA, 6.6 kV, 3-phase, 50 Hz, star-connected salient pole alternator with direct and quadrature axes reactance of 12.5  $\Omega$  and 10.5  $\Omega$ respectively is connected to an infinite bus. When the generator is operating at its rated MVA and power factor of 0.9 lagging, calculate the generated EMF per phase & the synchronizing power per mechanical degree of displacement.
- 4C. Differentiate the terms reluctance power and synchronizing power in the case of a synchronous generator.
- 5A. A textile manufacturing industry has an average load of 800 kW at a power factor of 0.75 lagging. To reduce the power factor tariff and to meet an additional load of 80kW, the industry has decided to install a motor aiming at improving the power factor to 0.9 lagging. Assume the motor efficiency as 86 %.

Suggest the type and kVA rating of the motor to be purchased. (04)

- 5B. Explain how the constructional features of the brushless DC motor help this machine avoid commutator and brushes using neat diagrams. (03)
- 5C. A choice has to be taken between a permanent magnet synchronous motor and switched reluctance motor of the same capacity for a variable speed drive system which requires high speed range of operation.

Justify your choice with technical comparison and suitable explanations

(04)

(05)

(02)

(03)

(04)

(04)

(02)

(03)