

Code No: RT31024

R13

SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, October/November -2017

ELECTRICAL MACHINES – III

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1 a) How the direction of rotation of 1-ph induction motor be reversed?
- b) What are the essential elements for generating emf in the alternator?
- c) What is an exciter? Give its significance.
- d) A machine with a large air gap has a high synchronizing power. Why?
- e) Draw the phasor diagram of a salient pole synchronous motor.
- f) What is hunting?

PART -B

- 2 a) Why are the compensated winding and the inter pole winding used in a universal motor for ac operation? Draw the schematic diagram of ac series motor?
- b) Discuss the constructional details of a salient pole synchronous machine with neat sketch.
- 3 a) What are the advantages and disadvantages of short pitched and distributed winding in alternator?
- b) Find the rms values of phase voltage for a 3-ph, 50Hz, 6 pole 72 slot alternator having a double layer winding with 20 turns/coil. The coil span is 5/6 of pole pitch. The speed is 1000rpm and flux per pole is 0.048Wb. Find (a) frequency (b) number of turns per phase (c) emf per phase.
- 4 The OC and sc test results for a 3-ph 50Hz, 6-pole 440V, Y-connected alternator are as follows

I_f	20	40	60	80	100	120	140	160	180	200
V_{oc}	1250	2500	3650	4450	4950	5150	5300	5440	5530	5600

When the alternator terminals are short circuited, a field current of 84A is needed to circulate the full load current. Find the regulation at full load, rated voltage, and power factors of (a) unity (b) 0.8 lagging using mmf method.

- 5 a) What do you understand by "power angle of an alternator"? Will it increase or decrease if the input to the prime mover of the alternator connected to an infinite bus is increased? Explain
- b) Two similar 400V, 3-ph alternators share equal kw power delivered to a balanced 3-ph 50kw, 0.8pf lag load. If the power factor of one is 0.95 lag, find the power factor and the current supplied by the other machine.
- 6 a) Derive the expression for power developed by the synchronous motor
- b) Draw the phasor diagrams of synchronous motor for unity, leading and lagging power factor conditions.
- 7 List and Explain the Starting methods for synchronous motor.

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PART -A

- 1 a) Why the ac series motors are provided with inter poles?
- b) What type of rotor is adopted for high speed alternators?
- c) Write about magnetizing and demagnetizing effects.
- d) At what power angle a synchronous generator will develop maximum power?
- e) Write about synchronous condenser.
- f) Why dampers are used in synchronous motor?

PART -B

- 2 a) A 150W, 4-pole 110V, 1-ph induction motor delivers rated output at a speed of 1.425 rpm. The total copper loss at full load is 30W. Determine the full load efficiency. The rotational losses equal 25watts and neglect stator copper loss. Also determine the copper losses caused by the two fields.
- b) Explain why a single phase Induction motor is not self starting. Discuss its operation based on double field revolving theory?
- 3 a) Find the rms values of phase voltage for a 3-ph, 50Hz, 20pole 180 slot alternator having a single layer winding with full pitch coils, the coils being connected in 60° phase groups, each coil having 6 turns. All the coils of a phase are in series. Flux per pole=0.025wb.
- b) What is the effect of armature reaction? Show its effect is included into phasor diagrams? Draw the phasor diagrams for lagging, leading and unity power factors.
- 4 The OC and sc test results for a 3-ph 50Hz,6-pole 440V,Y-connected alternator are as follows

I_f	2	4	6	7	8	10	12	14
V_{oc}	156	288	396	440	474	530	568	592

A field current of 7A is needed to circulate the full load rated armature current of 40A under short circuit conditions. The field current for rated terminal voltage under full load zero power conditions is 15A. The armature resistance is 0.2 ohms/ph. Find the regulation at full load current of 40A at 0.8 lagging pf. Using (a) mmf method (b) potier triangle method. And also comment on the results

- 5 a) Derive the condition for maximum power output of a synchronous generator connected to infinite bus bars operating at constant excitation.
- b) Two Ac generators running in parallel supplying a lighting load of 2000kw and a motor load of 4000kw at 0.8pf lagging. One machine is loaded to 2400kw at 0.95pf lagging. What is the output and power factor of the second machine.

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- 6 a) Is it possible to vary the speed of synchronous motor by varying the field excitation or by any other method? Explain what happens when the field current is (a) increased (b) decreased.
- b) A 1MVA, 3.3kV, 50Hz 6-pole 3 ph round rotor synchronous motor has a p.u resistance of 0.01 and pu synchronous reactance of 0.8. If $E=1.4$ pu, find the value of maximum power input and corresponding armature current and power factor.
- 7 a) What is a constant power circle for synchronous motor? Explain how it can be derived?
- b) What are the merits and demerits of synchronous motor?

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PART -A

- 1 a) Why are ac series motors built with large number of armature conductors?
- b) What is the necessity of chording in the armature winding of a synchronous machine?
- c) Why voltage regulation of an alternator is negative for leading pf?
- d) Why are alternators put in parallel?
- e) What is the effect of increase in excitation of a synchronous motor?
- f) How is the hunting avoided in a synchronous motor?

PART -B

- 2 a) Explain the two field revolving theory. Give its torque speed characteristics. Why these motors have a zero starting torque? Show that this motor can run in either direction.
- b) A single phase series motor with salient pole has a total resistance of 15ohms leakage reactance of 40ohms, mutual reactance of 80ohms(in d-axis), and 50ohms(in q-axis), If the stray power losses are 20 watts, calculate the current, speed and power factor of the motor at full load.
- 3 a) Explain how the induced emf is effected by (i) pitch factor and (ii) distribution factor.
- b) The stator of a 3-ph, 16-pole alternator has 144 slots and 10 conductors per slot connected in two layers and the conductors of each phase are connected in series. If the speed of the alternator is 375rpm. Find the line voltage if the flux per pole is 0.03Wb sinusoidally distributed and if the coil span is 150° electrical.
- 4 a) Describe a method to determine direct axis and quadrature axis reactances of a salient pole alternator.
- b) The OC and sc test results for a 3-ph 50Hz,1500kva ,6600V,Y-connected alternator are as follows

Field AT/pole	0	3000	6000	16500	20672
Voc	0	900	1780	3820	4080
Isc	0	65.6	131.22	---	---

The effective armature resistance/ph is 0.093 ohms and synchronous reactance as 8.5ohms. Estimate the full load percentage regulation using mmf method at 0.8 pf lagging.

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- 5 a) The following two synchronous machines are operating in parallel
Machine A: 50MW 6% speed regulation
Machine B : 50MW 3% speed regulation
i) Determine the load taken by each machine for a total load of 80MW when the speed changers are set to give rated speed at 100% rated output
ii) The speed changer of machine A is so adjusted that 80MW is equally shared.
Find the output of machine A for the rated speed and also its percentage speed at no-load.
- b) Explain the factors which affect the sharing of load between two alternators running in parallel.
- 6 a) A 2000V, 50Hz 4-pole 3 ph round rotor synchronous motor runs at 1500rpm has a resistance neglected and synchronous reactance of 3 ohms/ph. The excitation is constant to an open circuit voltage of 2000V. Find the power output of maximum power input, power factor and torque developed for an armature current of 200A.
- b) Explain the action of synchronous motor under loaded conditions.
- 7 Show that the locus of stator current for a constant output of 3-ph synchronous motor connected to a constant voltage, constant frequency bus bar is a circle.

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PART -A

- 1 a) What is the effect of increasing rotor resistance on 1-ph induction motor? [3M]
- b) Calculate pitch factor of the winding having 36 stator slots. [4M]
- c) Why synchronous impedance method does have poor voltage regulation?
- d) Why the speed of the synchronous generator is kept constant at synchronous speed.
- e) What are the applications of synchronous condenser?
- f) How can the speed of the synchronous motor varied?

PART -B

- 2 Explain about the necessity to provide compensating winding to ac series motor? Also briefly mention different schemes used for compensation? And list the common applications of AC series motors.
- 3 a) Explain the effects of armature reaction for leading power factor load with neat phasor diagrams.
- b) The stator of a 3-ph, 16-pole alternator has 144 slots and there are 4 conductors per slot connected in two layers and the conductors of each phase are connected in series. If the speed of the alternator is 375rpm. Calculate the emf induced per phase. Resultant flux in the airgap is 5×10^{-2} Wb/pole, sinusoidally distributed. Assume the coil span as 150° electrical.
- 4 The OC and sc test results for a 3-ph 50Hz, 1000kVA, 2000V, Y-connected alternator are as follows

I_f	10	20	25	30	40	50
V_{oc}	800	1500	1760	2000	2350	2600
I_{sc}	--	200	250	300	---	---

The effective armature resistance/ph is 0.5 ohms. Estimate the full load percentage regulation using mmf method at 0.707 pf lagging and 0.8 pf leading.

- 5 a) Two identical 2MVA alternators operate in parallel. The governor of first machine is such that the frequency drops uniformly from 50Hz on no-load to 47.5Hz to 48Hz. How will they share a load of 3MW?
- b) Discuss the effect of change in excitation and change in mechanical power input on the operation of an alternator on infinite bus?
- 6 A 6600V, 3ph Y-connected synchronous motor works at constant voltage and constant excitation. Its synchronous impedance is $2 + j20$ ohm per phase. When the input is 1000kW, the power factor is 0.8 leading. Find the power factor when the input is increased to 1500kW.
- 7 Explain the procedure to determine the V and inverted V- curves of a synchronous motor.
