BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) EXAMINATION, 2019

(3rd Year, 1st Semester)

ELECTRICAL MACHINES – III

Time : Three Hours Full Marks : 100

(50 marks for each part)

Use a separate Answer Script for each part.

PART – I

1. Answer any one from (a) and (b): 10

   (a) Explain the double revolving field theory for single phase induction motor and also prove that a single phase induction motor cannot produce starting torque. Show that this motor can be forced to run in either direction.

   (b) Develop an expression for the resultant torque of a single phase induction motor when running with slip s. Explain how the core losses are accounted for in determining the shaft power output.

2. Answer any one from (a) and (b): 10

   (a) Derive the equivalent circuit of a single phase induction motor with the help of double revolving field theory.

   (b) Explain how the equivalent circuit parameters of a single phase induction motor can be determined experimentally. State various assumptions made.

3. Answer any one from (a) and (b): 10

   (a) In a single phase capacitor induction motor, it is required that the auxiliary winding current should lead the main winding current by 90°, at the time of starting. Find the value of capacitive reactance in series with the auxiliary winding in terms of two winding constants.

   (b) What are the two kinds of emfs induced in the armature of ac commutator machines? Derive expressions for these emfs in case field flux is pulsating.

4. Answer any one from (a) and (b): 10

(a) What is single phase series motor? Explain its working principle. Draw and explain the phasor diagram of a single phase series motor.

(b) Show with the help of phasor diagrams that a compensated series motor possesses better speed-torque characteristics, better power factor operation and improved commutation as compared to an uncompensated series motor.

5. Answer any one from (a) and (b): 10

(a) A 230 volt, 50 Hz, 4-pole single-phase induction motor has the following equivalent circuit impedances:

$R_{1m} = 2.2\ \Omega$, $R'_2 = 4.5\ \Omega$

$X_{1m} = 3.1\ \Omega$, $X'_2 = 2.6\ \Omega$, $X_M = 80\ \Omega$

Friction, windage and core loss = 40 watt

For a slip of 0.03 pu, calculate input current, power factor, developed power, output power and efficiency.

(b) The following data relates to tests on a 110 volt, 150 watt, 50 Hz, 6 pole single-phase induction motor.

No-load test : 110 volts, 63 watts, 2.7 amps.

Blocked rotor test : 55 volts, 212 watts, 5.8 amps.

The stator winding resistance is 2.5 Ω and during the blocked rotor test, the starting winding is open.

Determine the equivalent circuit parameters. Also find the core, friction and windage losses.

PART-II.

Answer ***any three*** questions from this part.
Two marks are reserved for neat and well organised answer

6. Justify the following (any four) 4X4

a) O C C of an alternator can shift with speed, but S C C remains almost fixed with operating speed.

b) Slip test is performed at a speed slightly less than the synchronous speed.

c) Liquid hydrogen is used as coolant for the big alternators.

d) Zero power factor characteristic (ZPFC) of an alternator does not start from origin.

e) Mmf method to determine voltage regulation of an alternator is optimistic.

f) Hydro alternators run at low speed.

7.	a) What do you understand by voltage regulation of a three phase alternator? Explain with help of phasor diagrams the effect of load power factor on the same.	8
	b) A 6.6kV 3-phase 50 Hz star connected alternator gave the following test data: OC Test: If=3.5 A, Armature Voltage (E_0) = 6.6 KV SC Test: : If = 1.0 A, Armature Current (Ia)=450A If per phase armature resistance, ra =0.4 Ω, calculate the voltage regulation at a load current of 350 A at 0.8 p.f. lagging. (Assume linear magnetic circuit)	*8*
8.	a) Develop the power angle characteristic of cylindrical rotor alternator and sketch the same. Also derive the expression for load angle at which maximum power can occur.	8
	b) What do you understand by "Cylindrical Rotor Theory"? Why 'Cylindrical Rotor Theory' is not applicable for salient pole machines?	8
9	a) Show that the synchronous motors do not have inherent starting torque. Discuss different	8

	starting techniques of synchronous motors.	
	b) A 50 MVA 3-phase star connected 11kV 12pole, 50 Hz synchronous motor has reactances of X_d=2 Ω and X_q= 1.1 Ω. At full load, unity power factor and rated voltage, compute its: a) Excitation voltage b) Load angle	8
10	Write short notes on any Two a) Synchronization of alternators with infinite bus. b) V-curve of alternators c) Zero Power factor method for calculation of voltage regulation. d) Synchronous-induction motors	8 + 8