Exam Date & Time: 02-Dec-2019 (02:00 PM - 05:00 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES END SEMESTER THEORY EXAMINATION - NOVEMBER/ DECEMBER 2019 IV SEMESTER B.Sc.(Applied Sciences)in Engg. ELECTRICAL MACHINES [IEE 244]

Marks: 100

Duration: 180 mins.

Answer 5 out of 8 questions.

1) A)	 i) What is a transformer? Explain the working principle of the transformer with near sketch. ii) With neat schematic diagrams, explain the construction details of core and she type transformers. 	
B)	A single-phase transformer has 400 primary and 1000 secondary turns. The net cross-sectional area of the core is 60cm2. If the primary winding be connected	(10)

- to
 - a 50Hz supply at 520V, calculate:
 - i) The peak value of flux density in the core.
 - ii) The voltage induced in the secondary winding.
- A 4KVA, 200/400V, 1-phase transformer has equivalent resistance and reactance (10) referred to L.V. side equal to 0.5Ω and 1.5Ω respectively. Find the terminal voltage on the H.V. side when it supplies three-fourth full load at power factor of 0.8, the supply voltage being 220V. Hence find the output of the transformer and its efficiency if the core losses are 100W.
 - B) A 100 KVA transformer has 400 turns on the primary and 80 turns on the (10) secondary. The primary and secondary resistances are 0.3Ω and 0.01Ω respectively and the corresponding leakage reactance's are 1.1 Ω and 0.035Ω . Respectively

and the corresponding leakage reactance's are 1.1 Ω and 0.035 $\Omega.$ Respectively. The supply voltage is 2200 Volts. Calculate:

i) The equivalent impedance referred to the primary and.

ii) The voltage regulation and the secondary terminal voltage for full load having a power factor of: a) 0.8 lagging b) 0.8 leading.

- ³⁾ Deduce the complete circuit of a single phase transformer and using this equivalent ⁽¹⁰⁾ circuit draw the vector diagram of the transformer when it is supplying a leading power factor load.
 - B) The following test results were obtained for a 10 KVA, 400/100 volts, 50 Hz, (10) transformer
 O.C.Test :100 V 3A 80W ON L.V
 S.C. Test: 10V 25A 100W ON H.V

Find

i) The voltage regulation at 0.8 power factor lead.ii) The efficiency at half load, 0.9 p.f

- Explain the principle of operation of a three phase induction motor. (4)
 A)

 i
 Draw the schematic diagrams of 3-phase squirrel-cage rotor and phase-wound rotor and explain their constructional features.
 i) Obtain the condition for maximum torque of a 3 phase induction motor. (10)
 ii) A 3 phase induction motor having a star connected rotor has an induced emf of 80 volts between slip rings at standstill on open circuit. The rotor has a resistance and reactance per phase of 1Ω and 4Ω respectively. Calculate current / phase and power factor when:
 - a) Slip rings are short circuited
 - b) Slip rings are connected to a star connected rheostat of 3Ω per phase.
- ⁵⁾ Write an advantages of stationary armature of alternator and also explain the operation of alternator with relevant sketches. ⁽¹⁰⁾
 - A) B)

4)

- A 3 phase, 10 pole, star connected alternator runs at 600 rpm. It has 120 stator slots ⁽¹⁰⁾ with 8 conductors per slot. The conductors of each phase are connected in series. If the winding is short chorded by two slots, determine the r.m.s value of phase and line electromotive forces if the flux per pole is 56mWb.
- ⁶⁾ With a neat diagram, explain an experimental procedure to determine the Xd and ⁽¹⁰⁾ Xg of a salient pole alternator.
 - A)
 - B) The open circuit and short circuit test readings for a 3 phase, star connected 1000 kVA, 2000 (10) V, 50Hz synchronous generator are:

Field current(A)	10	20	30	40	50	60
OC voltage (L-L) (V)	800	1500	2000	2350	2600	2750
SC current (A)	-	200	300	-	-	-

The effective armature resistance is 0.15 ohm per phase. Determine the full load percentage regulation at 0.8 p.f. lagging by MMF method.

- ⁷⁾ A Draw salient pole type and non-salient pole type rotors of a synchronous motor ⁽¹⁰⁾ and explain.
 - A) B Mention some of the characteristic features of a synchronous motor.
 - A 500V, 1-phase synchronous motor gives a net output mechanical power of 7.46 (10) kW and operates at 0.9 power factor lagging. Its effective resistance is 0.8Ω. If the iron loss and mechanical losses are 500 W and excitation losses are 800 W, estimate the armature current. Calculate the commercial efficiency.
- ⁸⁾ What is a synchronous condenser? Explain how pf improvement is achieved by this ⁽¹⁰⁾ method. List the application of synchronous motor.
 - A) B)
- The input to an 11000V, 3-phase, star-connected synchronous motor is 60A. (10) The effective resistance and synchronous reactance per phase are respectively 1Ω and 30Ω . Find:
 - i) The power supplied to the motor
 - ii) Mechanical power developed and
 - iii) Induced e.m.f. for a power factor of 0.8 leading

