Code No: R31025 **R10** **Set No: 1**

III B.Tech. I Semester Supplementary Examinations, June/July -2014

ELECTRICAL MACHINES – III

(Electrical and Electronics Engineering)

Time: 3 Hours Max Marks: 75

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Distinguish between integral slot and fractional slot windings and their merits and demerits. (7)
   b) Calculate the speed and open circuit line and phase voltages of a 4-pole,3-phase, 50 Hz, star-connected alternator with 36 slots and 30 conductors per slot. The flux per pole is 0.0496Wb and is sinusoidally distributed. (8)

2. a) What happens to the value of synchronous reactance if air gap is increased? (4)
   b) Discuss the factors affecting the terminal voltage of an alternator. (4)
   c) A 3-phase star connected alternator supplies a load of 1000kW at a power factor of 0.8 lagging with a terminal voltage of 11kV.Its armature resistance is 0.4 ohms per phase while synchronous reactance is 3 ohms per phase. Calculate the line value of e.m.f. generated and the regulation at this load. (7)

3. a) How do you calculate synchronous impedance experimentally? (7)
   b) A 100kVA,3000V,50Hz 3-phase star –connected alternator has effective armature resistance of 0.2 ohms. The field current of 40A produce short-circuit current of 200A and an open circuit e.m.f of 1040V(line). Calculate the full-load voltage regulation at 0.8 p.f. lagging and 0.8 p.f. leading. Draw phasor diagrams. (8)

4. a) What conditions must be fulfilled before an alternator can be connected to an infinite bus? (7)
   b) Two 750 kW alternators operate in parallel. The speed regulation of one set is 100% to 102% from full-load to no-load and that of the other is 100% to 104%. How will the two alternators share a load of 1000kW and at what load will one machine cease to supply any portion of the load? (8)

5. a)(i) What is meant by hunting in a synchronous motor? (4)
   (ii) What are the salient features of a synchronous motor? (3)
   b) A 3-phase ,500V,star connected synchronous motor gives net output of 17kW on full load operating at 0.9 lagging power factor. Its armature resistance is 0.8Ω per phase. The mechanical losses are 1300W. Estimate the current drawn by the motor and full load efficiency. (8)

6. a) Explain the power circle diagrams of the synchronous motor. (10)
   b) Why it is necessary to increase the excitation to obtain minimum current with the application of load. (5)

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7. a) Explain how the performance of a single phase induction motor is estimated from the equivalent circuit? (7)
   b) Find the mechanical power output of a 185 watts,4 pole 110 volts,50Hz single phase induction motor whose constants are given below at a slip of 0.05.
   $R_1 = 1.86\Omega$ $X_1 = 2.56\Omega$ $m = 53.5\Omega$ $R_2 = 3.56\Omega$ $X_2 = 2.56\Omega$
   Core loss=40 watts; friction and windage losses= 13.0 watts. (8)

8. a) Compare the constructional features of A.C series motor with D.C series motor.
   b) Write a note on universal motor. (10+5)

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ELECTRICAL MACHINES – III

(Electrical and Electronics Engineering)

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1. a) Derive an expression for an induced e.m.f in a synchronous generator. Also explain how the e.m.f. is having sinusoidal waveform. (7)
   b) A 3 phase , 16 pole ,star connected alternator has 144 slots on the armature periphery. Each slot contains 10 conductors. It is driven at 375 r.p.m. The line value of e.m.f available across the terminals is observed to be 2.657kV. Find the frequency of the induced e.m.f and the flux pre pole. (8)

2. a) Define voltage regulation of an alternator. Explain the various factors, which may affect the regulation of an alternator. (7)
   b) A 3-phase star connected alternator is rated at 1500kVA, 1200V. The armature effective resistance and synchronous reactance are 2Ω and35Ω respectively per phase. Calculate the percentage regulation for a load of 1200kW at power factor of 0.8 lagging. (8)

3. a) Explain the two reaction theory applicable to salient pole synchronous machine.
   b) A 3-phase alternator has a direct-axis synchronous reactance of 0.7 p.u and a quadrature axis synchronous reactance of 0.4 p.u. Draw the vector diagram for full load 0.8 p.f. lagging and obtain there from (i) the load angle and (ii) the no -load per unit voltage. (8+7)

4. a) Define the significance of transient and sub-transient reactance's in an alternator.
   b) A 5000kVA,10kV,1500 r.p.m.,50Hz alternator runs in parallel with other machines. Its synchronous reactance is 20%. Find the synchronizing power per unit mechanical angle of the phase displacement for (i) No load and (ii) Full load at0.8 p.f. lag. (7+8)
   Also calculate the synchronizing torque if the mechanical displacement is 0.50.

5. a) (i) Explain V and inverted V curves. (5)
   (ii) Explain the purpose of using damper windings in a synchronous machine. (3)
   b) A 3-phase,3300V,star connected synchronous motor has an effective resistance and synchronous reactance of 2.0Ω and 18.0Ω per phase respectively. If the open circuit generated e.m.f. is 3800V between lines, calculate
   (i) The maximum total mechanical power that the motor can developed and
   (ii) The current and power factor at the maximum mechanical power. (7)

6. Is the synchronous motor self-starting? If not,what are the methods adopted for starting it? (15)

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7. a) Describe cross field theory as applied to single phase induction motor. (7)
   b) The following tests results were obtained in respect of 230 volts single phase induction
   motor:
   No load tests: 230V, 6.25A, 360 watts
   Locked rotor tests: 126V, 15.0A, 577 watts
   Stator winding resistance= 1.5 ohms
   Draw the equivalent circuit diagram with parameters. (8)

8. a) Write short notes on:
   (i) permanent magnet d.c. motor
   (ii) permanent magnet a.c. motor. (8)
   b) Write a note on hysteresis motor and its applications. (7)

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(Electrical and Electronics Engineering)

Time: 3 Hours Max Marks: 75

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1. a) Derive the expressions for distribution and pitch factors. (7)
   b) A single phase 1500 r.p.m,4 pole alternator has 8 conductors per slot with total of 24 slots. The winding is short pitched by 1/6th of full pitch. Assume distributed winding with flux per pole as 0.05Wb.Calculate the induced e.m.f. (8)

2. a) Explain the phenomena of armature reaction when an alternator is delivering a load current at (i) purely lagging p.f, (ii) unity p.f. and (iii) purely leading p.f. (7)
   b) A 1200kVA, 6600V, 3-phase star connected alternator has its armature resistance as 0.25Ω per phase and its synchronous reactance as 5Ω per phase. Calculate its regulation if its delivers a full load at (i)0.8 lagging and (ii) 0.8 leading p.f. (8)

3. a) Explain the terms direct –axis synchronous reactance and quadrature-axis synchronous reactance of a salient –pole alternator. On what factors do these values depend? (5)
   b) A 30 kVA,440V,50Hz,3-phase,star-connected alternator gave the following test data:

Field current(A) :	2	4	6	7	8	10	12	14
Terminal voltage(V):	155	287	395	440	475	530	570	592
S.C current(A) :	11	22	34	40	46	57	69	80

   Resistance between any two terminals is 0.3 ohms. Find the regulation at full load,0.8 p.f. lagging, by MMF method. (10)

4. a) Derive the expression for load sharing between the dissimilar alternators. (7)
   b) Two exactly similar turbo –alternators are rated 20MW each. They are running in parallel. The speed-load characteristics of the driving turbines are such that the frequency of alternator 1 drop uniformly from 50Hz on no-load to 48Hz on full load, and that of alternator 2 from 50Hz to 48.5Hz.How will the two machines share a load of 30MW ? (8)

5. a) Derive the torque developed in a synchronous motor. (7)
   b) A 15kW,400V, 50Hz, 3-phase star connected synchronous motor with impedance of (1+j5.0)Ω/phase is working at rated voltage and rated frequency. Find the load angle, armature current and power factor when the excitation is adjusted to 480V. (8)

6. a) Show that the current locus of a synchronous motor developing constant power is a circle. Determine its center and radius. (7)
   b) What are the various methods of making synchronous motors self starting? (8)

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7. a) Explain what is meant by the split-phase method of motor starting. (7)
   b) A 220V,50Hz,4 pole single phase induction motor has the following equivalent circuit parameters.
   $R_1 = 3.6\ ohms$ $X_1 = X_2 = 15.6\ ohms$; $R_2 = 6.8\ ohms$; $X_0 = 96\ ohms$
   The rotational losses of the motor are estimated to be 80 watts. Calculate the current, power factor and efficiency when the motor is running 1410 r.p.m. (8)

8. a) Write a note on reluctance motor and its applications. (8)
   b) Explain about universal motor with neat diagrams. (7)

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Code No: R31025 **R10** **Set No: 4**

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(Electrical and Electronics Engineering)

Time: 3 Hours Max Marks: 75

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1. a) Describe the main constructional features of alternator. (7)
   b) A 3-phase 4-pole synchronous generator has a double layer winding having four turns per coil placed in a total of 48 slots. If the flux per pole of the generator is 2x106 lines and speed of the rotor is 1500 r.p.m. Calculate the magnitude of generated voltage per phase. (8)

2. a) Draw and explain the phasor diagram of alternator under loaded conditions. (7)
   b) A 3-phase star-connected alternator is rated at 1600kVA, 13, 500V.The armature effective resistance and synchronous reactance are 1.5Ω and 30Ω respectively per phase. Calculate the percentage regulation for a load of 1280kW at power factors of (i)0.8 leading, and(ii)0.8 lagging (iii) unity. (8)

3. a) Explain the merits and demerits of E.M.F and M.M.F. methods. Explain what are the assumptions made in each case. (5)
   b) Calculate from the observations taken on a 125kVA, 400V,3-phase alternator, the % regulation for half load condition at 0.8 leading p.f. Oc test observation:

I_f(A) :	0	2	4	6	8	10
V_{OC} (Vline):	0	80	140	200	250	300

   While full load current is obtained on short circuit condition at a field current of 8A. Assume star connection and R_a=0.1Ω/ph. The short circuit current variation with respect to field current is linear. (10)

4. a) Discuss load sharing between two alternators. (7)
   b) Two single phase alternators operate in parallel and supply a load impedance of (3+j4)Ω. If the impedance of the machine is (0.2+j2) and e.m.f.s are (220+j0) and (220+j0) volts respectively, determine for each machine (i) terminal voltage(ii) power factor and (iii)output. (8)

5. a) (i)Explain the principle of operation of a synchronous motor. (5)
      (ii) Explain synchronous condenser. (3)
   b) A 750 kW,11kV,3-phase star connected synchronous motor has a synchronous reactance of 35Ω/phase and negligible resistance. Determine the excitation e.m.f. per phase when the motor is operating on full load at 0.8 p.f. leading. Its efficiency under this condition is 93%. (7)

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6. a) Explain the effect of variable excitation on the behavior of the synchronous motor under constant load condition. (7)
   b) Explain the methods of starting the synchronous motors. (8)

7. a) Explain the principle of operation and constructional features of a single phase induction motor. (7)
   b) A laboratory test on single phase induction motor has given the following data with rotational losses being equal to 17W.
   No load tests: 110V 2.8A 60W
   Blocked rotor tests: 110V 14.8A 1130W
   Determine the parameters of the equivalent circuit. (8)

8. a) Explain about single phase A.C. series motor with neat diagrams. (7)
   b) Explain about permanent magnet D.C motor with neat diagrams and give its applications. (8)

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