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

III B.Tech. I Semester Regular Examinations, November/December - 2012

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. Explain the constructional features and principle operation of a single phase induction motor. [15]

2. (a) Explain the working principle of an alternator with the help of a neat diagram.
(b) A 3-phase, 16-pole synchronous generator has a resultant air-gap flux of 0.06 Wb per pole. The flux is distributed sinusoidally over the pole. The stator has 2 slots per pole per phase and 4 conductors per slot are accommodated in layers. The coil span is 150^0 electrical. Calculate the phase and line induced voltages when the machine runs at 375 rpm. [7+8]

3. (a) Explain the leakage reactance and armature reactance of an alternator.
(b) The phase EMF of a 3-phase alternator consists of fundamental, 20% of 3rd harmonic and 10% of fifth harmonic. The amplitude of fundamental is 1000 V. Calculate the RMS value of line and phase voltage, when the alternator is connected in (i) Star (ii) Delta [7+8]

4. (a) Explain the two reaction theory as applied to salient pole synchronous machine?
(b) A 1 MVA, 11kV, 3-phase, star connected synchronous machine has the following OCC test data

Filed current I_f (A)	40	110	140	180
E_{OL} (kV)	7	12.5	13.75	15

where E_{OL} is line to line voltage at no load. The short circuit test yielded full load current at a field current of 65A, the armature resistance is negligible calculate the voltage regulation at full load 0.8 power factor lagging by MMF method. [8+7]

5. (a) What is meant by synchronization? Explain the way of synchroning an alternator to the infinite bus bars.
(b) Two identical 3 MVA alternators are running in parallel. The frequency drops from no load to full load for the two alternators are 50Hz to 47 Hz and 50Hz to 48Hz respectively. (i) How will they share a load of 4000 kW (ii) what is maximum load they can share at unity power factor without overloading any alternator? [7+8]

6. (a) Explain the 'V-curves' and 'inverted V-curves' of synchronous motor.
(b) Explain the various power stages of synchronous motor. What are the various losses taking place in synchronous motor. . [8+7]

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7. (a) Show that the locus of power of a synchronous machine is circle? Give the co-ordinates of the power circle.
   (b) Explain the hunting of a synchronous machine. What is the purpose of damper windings in a synchronous machine? [8+7]

8. (a) Compare AC series motor and Universal motor and mention their operational difficulties.
   (b) Explain the working principle of permanent magnet motors. [8+7]

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Code No: R31025 **R10** **Set No: 2**

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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. Show that a single phase winding when excited by a single phase supply produce two equal and opposite revolving fields. [15]

2. (a) Explain about integral slot and fractional slot windings.
   (b) A 4 pole alternator has an armature with 25 slots and 8 conductors per slot. The flux per pole is 0.06 Wb and machine rotates at 1500 rpm. Calculate the EMF generated, if the winding factor is 0.96 and all the conductor in a phase are connected in series. [7+8]
3. (a) Explain the load characteristics of an alternator.
   (b) Find the r.m.s value of fundamental and third harmonic EMF per phase for an alternator having the following data: 50Hz, 3-phase, 20 poles, 4 slot/pole/phase, double layer winding with 6 conductors/slot, coil span of 150^0 electrical, the fundamental flux per pole is 0.1 Wb and third harmonic is 17% of fundamental. All coils of a phase are connected in series. [7+8]

4. (a) Explain the Potier triangle method of finding the voltage regulation of an alternator.
   (b) A 3-phase, 200 kVA, 1.1 kV, 50 Hz star connected alternator having an effective per phase resistance of 0.62 ohms gave the following results:

Filed current (A)	20	35	50	80	100	120
Open circuit Voltage (V)	692.82	1120	1450	1750	1953	2180
Short circuit current (A)	0	20	40	60	80	100

   Using MMF method, find the voltage regulation at 100 A (i) 0.8 power factor lagging (ii) 0.8 power factor leading. [7+8]

5. (a) Discuss the phenomenon of sudden 3-phase short-circuit at armature terminals of an alternator. Draw the typical wave shape of the current and mark the different regions.
   (b) A 2 MVA, 3-phase, star connected, 4 pole, 750 rpm alternator is operating on 6000 V bus bars. The synchronous reactance is 6 ohms per phase. Find synchronizing power and torque for full load 0.8 power factor lagging. [8+7]

6. (a) Explain the construction and operating principle of synchronous motor.
   (b) Describe briefly the effect of varying excitation upon armature current and power factor of synchronous motor when the input power to motor is maintained constant [7+8].

7. (a) Why synchronous motor is not self starting? Explain the various starting methods of synchronous motor.
   (b) Explain the characteristics of synchronous induction motor. [8+7]

8. (a) Compare reluctance stepper motor and permanent magnet motor.
   (b) Explain the operation of a AC series motor with a neat diagram. [8+7]

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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) Why single phase, single winding induction motors are not self starting? How they can be started.
   (b) Derive equation for forward slip and backward slip of a single phase induction motor. [7+8]

2. (a) Derive the expression for EMF induced per phase in a 3-phase alternator? Mention how different winding factors affect the induced e.m.f.
   (b) A 4-Pole, 3-Phase, 50 Hz, star-connected alternator with 12 slots and 24 conductors per slot. The flux per pole is 0.3 Wb and is sinusoidally distributed. Calculate the line e.m.f generated at 50Hz. [8+7]

3. (a) Explain the effect of armature reaction on the EMF induced in the alternator. Is it possible to obtain load voltage more than EMF inducted? If yes, how?
   (b) A 16 pole, 3-phase star connected alternator has 144 slots. The coils are short pitched by one slot. The flux per pole is $\Phi = 100 \sin\theta + 30 \sin 3\theta + 20 \sin 5\theta$. Find the harmonics as percentage of phase voltage and line voltage. [8+7]

4. (a) Explain the synchronous impedance method for finding the voltage regulation of an alternator. Mention its limitations.
   (b) A 3-phase, star connected salient pole synchronous generator is driven at a speed near synchronous with the field circuit open and the stator is supplied from a balanced 3-phase supply. Voltmeter connected across the line gave minimum and maximum readings of 1190 V and 1220 Volts. The line current fluctuated between 125 and 240 Amp. Find the direct and quadrature axis reactances per phase. Neglect armature resistances. [9+6]

5. (a) What are the effects of change of excitation and mechanical power input on alternators operated in parallel.
   (b) The EMFs of two alternators are $3200\angle 20^0$ and $3000\angle 0^0$ V. Their synchronous impedances are $2.2 + j19\,\Omega$ per phase and $2.5 + j32\,\Omega$ per phase. The load impedance is $9 + j5\,\Omega$ per phase. Find the circulating current. [7+8]

6. (a) Derive the expression for the maximum power developed by a synchronous motor.
   (b) A 3-phase star connected 440 V; the synchronous motor takes a power input of 5 kW at rated voltage. Its synchronous reactance is 5 ohms per phase and resistance is negligible. If its excitation voltage is adjusted equal to rated voltage of 400V, compute the load angle, power factor and armature current. [8+7]

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7. (a) What is hunting. Discuss the problems with hunting.
   (b) What is meant by excitation circle? Explain the construction of excitation circle for a synchronous motor. [7+8]

8. Explain with neat diagrams the principle of operation of
   (a) AC series motor (b) Reluctance motor. [8+7]

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ELECTRICAL MACHINES -III

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Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Explain the operation of split phase single phase Induction motor with vector diagram.
   (b) Explain the working principle of a shaded pole motor. [8+7]

2. (a) Explain the various winding factors in an alternator? Explain the effects of these factors on induced e.m.f.
   (b) A 3-phase, star connected, 8 pole, 750 rpm alternator has 72 slots on its periphery. Each slot has 12conductors and the winding is short pitched by 2 slots. Find the pitch factor and distribution factor. Also, calculate the induced e.m.f between lines if the flux of 0.04wb is distributed sinusoidally. All the conductors in phase are connected in series. [7+8]

3. (a) What are harmonics? Explain the sources of harmonics. What are the various effects of harmonics on generated e.m.f in an alternator?
   (b) Draw the phasor diagrams of alternator, assuming the stator phase currents are to lagging, leading, deduce the expression for the induced voltage? [7+8]

4. (a) Explain how X_d and X_q of a salient pole alternator can be found experimentally.
   (b) A 1000 kVA, 11 kV, 3-phase star connected alternator has a resistance of 2 ohms per phase. The open circuit voltage and the voltage at rated full load current at zero power factor lagging are as follows:

Filed current I_f (A)	45	55	110	150	170
Line Voltage (V)	5900	7100	12600	13850	16000
Line Voltage (V) at ZPF	0	1500	8500	10550	12500

   Calculate the voltage regulation of the alternator by synchronous impedance method for full load current at 0.8 pf lagging [7+8]

5. (a) Show that in order to obtain a constant voltage, constant frequency of a practical bus bar system, the number of alternators connected in parallel should be as large as possible.
   (b) A 5 MVA, 10 kV, 1500 rpm, 3-phase, and 50 Hz alternator is operating on infinite bus bar. Find synchronizing power per mechanical degree of angular displacement at (i) No-load (ii) Full-load at rated voltage and 0.8pf lagging. [8+7]

6. (a) With the help of a vector diagram explain the operation of synchronous motor as synchronous condenser.
   (b) A sub-station operating at full load of 1200 kVA supplies a load at 0.7 power factor lagging. Calculate the permissible additional load at this power factor and the rating of synchronous condenser to raise the substation power to 0.9 lagging. [8+7]

7. (a) With neat diagram and explanation, show how damper winding prevents oscillations.
   (b) Explain the various starting methods of synchronous motor. [7+8]

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8. (a) Explain simply why a universal motor can operate from DC supply as well as AC supply.
   (b) Explain the principle of operation of a permanent magnet motor with neat diagram. [7+8]

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