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

III B.Tech. I Semester Supplementary Examinations, May 2013

**ELECTRICAL MACHINES -III**

(Electrical and Electronics Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

*****

1. (a) Explain why single phase induction motors are not self starting.
   (b) Write short notes on Double revolving field theory.

2. (a) Describe the constructional features of a salient pole synchronous generator.
   (b) A 3-phase, 50 Hz star connected alternator runs at 600 rpm. It has 60 stator slots with 4 conductors/slot. The flux per pole is 0.06 wb per pole and sinusoidally. Determine the phase and line emf's.

3. (a) Describe in detail, the nature and effects of armature reaction in a synchronous machine.
   (b) A 1000 KVA, 6.6 KV, 3 phase star connected synchronous generator has a synchronous reactance of 25 Ω per phase. It supplies a full load current at 0.8 lagging pf and a rated terminal voltage. Compute the terminal voltage for the same excitation when the generator supplies full – load current at 0.8 leading pf.

4. (a) Explain the M.M.F. method to pre-determine the regulation of an alternator.
   (b) The following data define the open circuit characteristic and the zero power factor load characteristic of a 15 MVA, 11KV, 3-phase, 50 Hz, Y- connected turbo-generator

| Field Ampere Turns | 10,000 | 18,000 | 24,000 | 30,000 | 40,000 | 45,000 | 50,000 |
|---|---|---|---|---|---|---|---|
| $V_{oc}$ line (KV) | 4.9 | 8.4 | 10.1 | 11.5 | 12.8 | 13.3 | 13.65 |
| Full load, zero power factor line voltage in KV | - | 0 | - | - | - | 10.2 | |

   Find the armature ampere-turns per pole, armature leakage reactance and synchronous reactance. Calculate the regulation for full load, 80% p.f lagging by ZPF method.

5. (a) Explain the method of synchronizing a 3-ph synchronous motor to the mains.
   (b) A 3.5 MVA, 3-ph alternators rated at 6.6kV has 32 poles. Its direct and quadrature – axis synchronous reactance are 9.6 Ω and 6 Ω respectively. Neglecting the armature resistance, determine the regulation and excitation emf needed to maintain 6.6kV at the terminals when supplying a load of 2.5MW at 0.8pf lagging. What maximum power can the generator supply at the rated terminal voltage, if the field become open-circuited?



|''|'||'|''|'|''''|

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

6. (a) Explain the operation of synchronous conductors.
   (b) A 20-pole, 693V, 50Hz, 3Φ, Δ-connected synchronous motor is operated at no-load with normal excitation. It has armature resistance per phase of 10Ω and negligible synchronous reactance. If rotor is retarded by $0.5^0$ (mech.) from its synchronous position, compute
   (i) Rotor displacement in electrical degrees (ii) armature emf/phase
   (iii) Armature current/phase (iv) power drawn by the motor
   (v) Power developed by the armature

7. (a) What is hunting? Discuss various methods to suppress the hunting.
   (b) Discuss in detail about the excitation circles.

8. Write short notes on:
   (a) Reluctance motor
   (b) Universal motor

*****





|''|'||'|''|'|''|

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

III B.Tech. I Semester Supplementary Examinations, May 2013

**ELECTRICAL MACHINES -III**

(Electrical and Electronics Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

*****

1. (a) Describe the construction, principle of operation of shaded pole induction motor. Also give some of the applications.
   (b) Name some of the starting methods of single-phase induction motors.

2. (a) Explain the effects of distributed winding and use of short pitched coils on the magnitude of generated voltage of alternator.
   (b) Calculate the RMS value of the induced emf per phase of a 10- pole, 3φ, 50 Hz alternator with 2 slots per pole per phase and 4 conductors per slot in two layers. The coil span is $150^0$. The flux per pole has a fundamental component of 0.12 Wb and a 20% third component.

3. (a) Explain the concept of replacing armature reaction by a reactance.
   (b) A 3-phase Y connected alternator is delivering 20 MW and 8 MVAR to an infinite bus at 11 KV. Synchronous impedance = 0+j3 ohm. Find load angle and excitation emf of the alternator.

4. (a) Explain the A.S.A method of predetermining the regulation of an alternator.
   (b) The open and short circuit test data on a 3-phase, 1 MVA, 3.6 KV, star connected synchronous generator is given below:

| Field current (Amps) | 60 | 70 | 80 | 90 | 100 | 110 |
|---|---|---|---|---|---|---|
| $V_{oc}$ line (Volts) | 2560 | 3000 | 3360 | 3600 | 3800 | 3960 |
| S.C Test (Amps) | 180 | - | - | - | - | - |

   Find the unsaturated synchronous reactance, the adjusted synchronous reactance and the short circuit ratio.

5. (a) What is synchronizing power? Explain its significance with parallel operation of alternators.
   (b) Two star connected synchronous generators connected in parallel have an emf of 1200 volts per phase share a common star connected load of impedance (2+j1.0) ohms/phase. The synchronous impedance of the machines are $Z_{s1}$ = (0.1+j2) ohms/phase and $Z_{s2}$ = (0.2+j3.0) ohms per phase respectively. Determine the common terminal voltage, load current, power outputs and the no load circulating current when two machines internal e.m.f's have a phase divergence of $5^0$ electrical.

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

6. (a) Derive an expression for power developed in a synchronous motor.
   (b) Draw the phasor diagram synchronous motor and explain.

7. (a) Develop the excitation circle for a cylindrical rotor synchronous motor. How are the circles helpful in studying the steady state behavior of synchronous motors?

   (b) A 3-phase, star-connected non-salient pole synchronous motor connected to a 6.6KV mains has an armature impedance of (2.5+j15.0) Ω/Phase. The excitation of the machine gives a generated emf of 7.0 KV. The iron and friction losses amount to 10KW. Determine the output of the motor when operating at a load angle of $31^0$(electrical).

8. Write short notes on:
   (a) Permanent magnet motor
   (b) AC series motor

*****





|''|'||'|''|'|''|

Code No: R31025 **R10** **Set No: 3**

III B.Tech. I Semester Supplementary Examinations, May 2013

**ELECTRICAL MACHINES -III**

(Electrical and Electronics Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

*****

1. (a) State the reasons for the inferior performance of single phase motors over three phase motors.
   (b) Describe the construction and principle of operation of shaded pole motor.

2. (a) Derive the equation for EMF for a 3-phase alternator.
   (b) A 3-phase, 16 pole alternator has a star connected winding with 144 slots and 12 conductors per slot. The flux per pole is 0.03 Weber and is sinsoidally distributed. The speed of the machine is 375 rpm. Find the frequency, the phase and line electromotive forces.

3. (a) How do the winding factors affect the waveform of the generated waveform of synchronous generator? What steps are taken to eliminate third and fifth harmonic components of the generated emf?
   (b) A 3-phase, Y connected alternator is operated at a constant voltage of 6.6KV and its excitation voltage is adjusted to 6.4KV. Find the maximum output power and pf at this power assuming $X_s$ = 1+j10 ohm per phase.

4. (a) Compare different regulation methods and conclude which method is advantageous.
   (b) A 15 KVA, 400 volts, 50 Hz, 3-phase, star connected alternator gave the following data:

| Fieldcurrent (Amps) | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 |
|---|---|---|---|---|---|---|---|
| $V_{oc}$ line (Volts) | 266 | 334 | 377 | 422 | 450 | 484 | 508 |

   An excitation of 2 Amps gave full load current on short circuit. Armature resistance per phase is 1 ohm. Calculate full load regulation at 0.8 p.f leading using MMF method.

5. (a) With the help of a phasor diagram, explain the effect of excitation control of an alternator operating with another alternator supplying a common load.
   (b) A 3-phase, 4000 KVA, 6.6 KV, 1500 RPM, 50 Hz alternator is running in parallel with infinite bus bars. Its synchronous reactance drop is 25%. Calculate the synchronizing power and torque per unit mechanical angle of phase displacement when the alternator operates at full load 0.8 p.f lagging.

6. (a) Explain why a synchronous motor is not self-starting. Describe any one method of starting a synchronous motor.
   (b) A 10 kW, 400 volts, 3-phase, star connected synchronous motor has synchronous impedance per phase of (0.35+j2.8) ohms. Find the torque angle and the voltage to which the motor must be excited to give a full load output at 0.856 pf lead. Assume efficiency to be 88 per cent.



|''|'||'|''|'|''''|

Code No: R31025 **R10** **Set No: 3**

7. (a) Explain the principle of operation of synchronous induction motor.
   (b) A 3-Phase, 400V, 50 Hz, 37.3KW, star connected synchronous motor has a full load of efficiency 88%. The synchronous impedance of the motor is (0.2+j1.6)Ω/phase. If the excitation of the motor is adjusted to give a leading pf of 0.9, calculate for full-load (i) the induced emf (ii) the total mechanical power developed.

8. Write short notes on:
   (a) Universal motors
   (b) Permanent magnet motor.

*****

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

III B.Tech. I Semester Supplementary Examinations, May 2013

**ELECTRICAL MACHINES -III**

(Electrical and Electronics Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

*****

1. (a) Explain why a single phase squirrel cage induction motor is not inherently self starting.
   (b) Describe the construction and principle of operation of split phase motor.

2. (a) Explain the importance of distributed armature winding in a synchronous generator. Derive an expression for distribution factor for such a winding.
   (b) A 3-phase, star connected alternator has the following data:
   Voltage required to be generated on open circuit = 4000 volts at 50 Hz; Speed =500 RPM;
   Stator slots per pole per phase = 3; Conductors per slot = 12.
   Calculate (i) no. of poles and (ii) useful flux per pole.
   Assume all conductor per phase to be connected in series and coil to be full pitch.

3. (a) Describe the harmonics in generated voltage and explain how they are suppressed.
   (b) A 3-phase, Y connected alternator connected to 6.6 KV bus bar has a synchronous impedance of 10 ohms per phase and a resistance of 2 ohms per phase. The excitation corresponds to an open circuit emf of 6 KV. What is the maximum load the machine can supply to the external circuit before dropping out of synchronism and what are the corresponding values of armature current and pf.?

4. (a) Develop phasor diagram for a salient pole alternator supplying a leading pf load and 2-reaction theory.
   (b) A 20 MVA, 11 KV, 3-phase, delta connected synchronous motor has a synchronous impedance of 15 Ω/phase. Windage friction and iron losses amount to 1200 KW. Find the value of the unity power factor current drawn by the motor at a shaft load of 15 MW. What is the excitation emf under this condition?

5. (a) Explain how an alternator is synchronized to the bus bars.
   (b) Two identical, 3-phase, star connected generators operating in parallel, share equally a total load of 750 kW at 6000 volts and power factor 0.8 lagging. The synchronous reactance and resistance of each machine are respectively 50 ohms and 2.5 ohms per phase. The field of the first generator is excited so that the armature current is 40 Amps. (lagging). Find
   (i) the armature current of the second alternator,
   (ii) the power factor of each machine.



|''|'||'|''|'|''|

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

6. (a) What are the salient features of a synchronous motor?
   (b) A 20-pole, 693 V, 50 Hz, 1500rpm, mesh connected synchronous motor has a synchronous impedance of 4 Ω/phase. It receives an input line current of 30 Amps. At a leading p.f of 0.8, find the line value of the induced emf and the load angle in mechanical degrees. If the mechanical load is thrown off without change of excitation, determine the magnitude of current under the new conditions. Neglect losses.

7. (a) Explain the phenomenon of hunting. Explain how this can be suppressed.
   (b) Explain different methods of standing of Synchronous motor.

8. Explain the principle of operation of AC series motor with a neat diagram. Discuss its applications.

*****