Code No: RR310205 **Set No. 1**

III B.Tech I Semester Regular Examinations, November 2005
ELECTROMECHANICS-III
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the constructional differences between round rotor and salient pole synchronous machines
   (b) Find the value of Kd for an alternator with 9 slots per pole for the following cases
      i. one winding in all the slots
      ii. one winding using only the first 2/3 of the slots/pole
      iii. three equal windings placed sequentially in 60^0 group [8+8]

2. (a) What are slot harmonics and how they are suppressed.
   (b) The armature of a single-phase alternator is wound completely with T single turn coils, which are uniformly distributed. The induced e.m.f. in each turn is 2V(rms). Calculate the e.m.f of the whole winding with T number of coils connected in series. [8+8]

3. (a) Develop the expression for finding voltage regulation of salient-pole alternator.
   (b) The no-load and full-load zero factor characteristics for a 23.5MVA, 13.8KV, 3-phase, star-connected turbo-generator are given below in per unit values: No-load characteristic:

I_f	0.10	0.20	0.40	0.60	0.80	1.0	1.2	1.4	1.6	2.0	2.5
V	0.13	0.23	0.45	0.69	0.87	1.0	1.09	1.15	1.21	1.28	1.36

Zero p.f. Characteristic:

I_f	1.2	1.3	1.4	1.6	1.8	2.0	2.2	2.4	2.6
V	0.015	0.13	0.25	0.49	0.69	0.83	0.92	0.99	1.04

Determine the regulation at full-load, 0.8p.f.lag by the zero p.f.method. Neglect armature resistance. [8+8]

4. (a) What is an infinite bus? State the characteristics of an infinite bus. What are the operating characteristics of an alternator connected to an infinite bus?
   (b) A 3 MVA,6-pole alternator runs at 1000 r.p.m in parallel with other machines on 3.3 KV bus-bars. The synchronous reactance is 20%.Calculate the synchronizing power per one mechanical degree of displacement and the corresponding synchronizing torque.
   (c) What is an infinite bus? State the characteristics of an infinite bus. What are the operating characteristics of an alternator connected to an infinite bus?[16]

5. (a) Explain the necessity of parallel operation of alternators.
   (b) Two 50MVA, 3-phase alternators operate in parallel. The settings of the governors are such that the rise in speed from full-load to no-load in 2% in one machine and 3% in the other, the characteristics being straight lines in both cases. If each machine is fully loaded when the total load is 100MW,what will be the load on each machine when the total load reduced 60MW? [8+8]

6. (a) What is the effect of load on a synchronous motor?
   (b) A 400V, 8KW, 3-phase synchronous motor has a negligible resistance and a synchronous reactance of 8 Ω per phase. Determine the minimum current and the corresponding induced emf for full load condition. Assume an efficiency of 88%? [8+8]

7. (a) What are the uses of damper windings in a synchronous motor?
   (b) Why it is necessary to increase the excitation to obtain minimum current with the application of load. [8+8]

8. Write short notes on following:
   (a) Double revolving field theory.
   (b) Capacitor Start single phase induction motor. [8+8]

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Code No: RR310205 **Set No. 2**

III B.Tech I Semester Regular Examinations, November 2005
ELECTROMECHANICS-III
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the essential difference between cylindrical and salient pole rotors used in large alternators.
   (b) A certain alternator has 6 slots per pole and the coils are short pitched by 1 slot. The coil span is 5 slot pitches. Calculate the pitch factor. [8+8]

2. (a) Discuss how synchronous impedance of alternator can be determined
   (b) A 4-pole, 3-phase, 50Hz,star-connected alternator has 60 slots, with 2 conductors per slot and having armature winding of the two-layer type. Coils are short-pitched in such a way that if one coil side lies in slot number 1,the other lies in slot number 13.Determine the useful flux per pole required to generate a line voltage of 6000V. [8+8]

3. (a) What is voltage regulation? Discuss the synchronous impedance method of calculating voltage regulation.
   (b) A 500V, 50KVA, 1-phase alternator has an effective resistance of 0.2Ω.A field current of 10A produces an armature current of 200A on short circuit and an emf of 450V on open circuit. Calculate
      i. Synchronous impedance and reactance
      ii. Full-load regulation with 0.8p.f. lagging. [8+8]

4. (a) Explain how regulation is determined from slip test
   (b) A 3-phase salient -pole synchronous generator has Xd=0.8 p.u.; Xq =0.5 p.u. and Ra =0.generator supplies full -load at 0.8 p.f. Lagging at rated terminal voltage. Compute
      i. power angle and
      ii. no-load voltage if excitation remains constant. [8+8]

5. (a) Explain the procedure to determine the following
      i. Sub transient reactance
      ii. Transient reactance
      iii. Steady state reactance
   (b) The speed regulation of two 500 KW alternators A and B running in parallel are 100% to 104% and 100% to 105% from full load to no load respectively. How will the two alternators share a load of 800KW and also find the load at which one machine ceases to supply any portion of the load? [8+8]

6. (a) What are the advantages and disadvantages of the synchronous motor?
   (b) A Synchronous motor takes 25KW from 400V supply mains. The synchronous reactance of the motor is 4Ω. Find the power factor at which the motor would operate when the exciting current is so adjusted that the generated emf is 500V. [8+8]

7. (a) What is the effect on synchronous motor when the load is changed.
   (b) A 3300V, star connected synchronous motor is operating at constant terminal voltage and constant excitation. Its synchronous impedance is (0.8+j5) Ω. It operates at a p.f of 0.8 leading when drawing 800KW from the mains. Find its power factor when the input is increased to 1200KW, excitation remaining constant. [8+8]

8. (a) Describe the constructional feature and principle of operation of a shaded pole motor.
   (b) Explain what is meant by the split-phase method of motor starting. [8+8]

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Code No: RR310205 **Set No. 3**

III B.Tech I Semester Regular Examinations, November 2005
ELECTROMECHANICS-III
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Describe the main constructional features of cylindrical rotor and salient pole alternators.
   (b) Derive the expressions for distribution and pitch factors. [8+8]

2. (a) Describe armature reaction and explain its effect on terminal voltage
   (b) Calculate the speed and open circuit line and phase voltages of a 4-pole, 3-phase, 50Hz,star-connected alternator with 36 slots and 30 conductors per slot. The flux per pole is 0.0496Wb and is sinusoidally distributed. [8+8]

3. (a) Define and Explain the terms synchronous impedance and voltage regulation of an alternator. State the assumptions made in the synchronous impedance method.
   (b) A 3-phase, 50Hz,star-connected, 2000KVA, 2300-V alternator gives a short cir cuit current of 600A for a certain field excitation. With the same excitation, the O.C.Voltage was 900V.The resistance between a pair of terminal was 0.12Ω.Find full - load regulation at
      i. u.p.f.
      ii. 0.8 p.f.lagging
      iii. 0.8 p.f.leading. [8+8]

4. (a) Describe the slip test method for the measurement of Xd to Xq of synchronous Machines.
   (b) A 3.5 MVA, slow-speed, 3-phase synchronous generator rated at 6.6KV has 32 poles its direct - and quadrature - axis synchronous reactances as measured by the slip test are 9.6Ω and 6Ω respectively. Neglecting armature, determine the regulation and the 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 becomes open-circuited? [8+8]

5. (a) Show that for alternators running in parallel, the division of load between them is governed mainly by the speed load characteristics of their prime movers.
   (b) Two 15 -KVA, 400v; 3-phase alternators in parallel supply a total load of 25 KVA at 0.8 power factor lagging. If one alternator shares half the power at unity power factor, determine the power factor and KVA shared by the other alternator. [8+8]

6. (a) Describe briefly the effect of varying excitation upon the armature current and power factor of a synchronous motor when input power to the motor is maintained constant.

   (b) A 400V, 50Hz, 37.3KW 3-phase star connected synchronous motor has a full load efficiency of 88%. The synchronous impedance of the motor is (0.2+j1.6)Ω per phase. If the excitation of the motor is adjusted to give a leading power factor of 0.9 calculate for full load

      i. the induced emf

      ii. the total mechanical power developed. [8+8]

7. (a) What are the uses of damper windings in a synchronous motor?

   (b) Why it is necessary to increase the excitation to obtain minimum current with the application of load. [8+8]

8. (a) Explain what is meant by the split-phase method of motor starting

   (b) Why are small fractional horse power ac series motors called universal motor? [8+8]

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Code No: RR310205 **Set No. 4**

III B.Tech I Semester Regular Examinations, November 2005
ELECTROMECHANICS-III
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the effect of distribution of winding and use of short-pitch coil on the magnitude of the generated voltage in an alternator.
   (b) Explain the constructional differences between round rotor and salient pole synchronous machines. [8+8]

2. (a) Derive emf equation for an alternator from fundamentals.
   (b) A 50Hz alternator has a flux of 0.1 wb/pole, sinusoid ally distributed. Calculate the rms value of the emf generated in one turn of the winding, which spans $^3/_4$ of a pole pitch. [8+8]

3. (a) Explain the potier - triangle method of determining the voltage regulation of an alternator.
   (b) A 3-phase, star- connected alternator is rated at 1600KVA and 13,5000V .The armature effect resistance and synchronous reactance per phase are 1.5Ω and 30Ω respectively. Calculate the percentage regulation for a load of 1280KW at p.f of
      i. 0.8 lagging
      ii. unity and
      iii. 0.8 leading. [8+8]

4. (a) Discuss about two reaction theory with relevant phasor diagram
   (b) A 4 pole, 50Hz, 22KV, 500 MVA synchronous generator having a synchrous reactance of 1.57 pu is feeding into a power system, which can be represented by a22KV infinite bus in series with a reactance of 0.4W.The generator excitation is continually adjusted (by means of an automatic voltage regulator) so as to maintain a terminal voltage of 22KV independent of the load on the generator
      i. Draw the phasor diagram, when the generator is feeding 250 MVA into the power system. Calculate the generator current, its power factor and real power fed by it. What is the excitation emf of the generator?
      ii. Repeat part (a) when the generator load is 500 MVA. [8+8]

5. (a) Explain the necessity of parallel operation of alternators.
   (b) Two 50MVA, 3-phase alternators operate in parallel. The settings of the governors are such that the rise in speed from full-load to no-load in 2% in one machine and 3% in the other, the characteristics being straight lines in

both cases. If each machine is fully loaded when the total load is 100MW,what will be the load on each machine when the total load reduced 60MW? [8+8]

6. (a) Explain about different torques of a synchronous motor?
   (b) A 400V, 3-phase synchronous motor takes 52.5A at a power factor of 0.8 leading. Calculate the power supplied and induced emf. The motor impedance per phase is (0.25+j3.2)Ω. [8+8]

7. (a) What could be the reasons if a synchronous motor fails to start?
   (b) The synchronous reactance per phase of a 3-phase star connected 6600V synchronous motor is 10Ω. For a certain load, the input is 900KW and the induced line emf is 8900V(line value). Evaluate the line current. Neglect resistance. [8+8]

8. (a) Why single-phase induction motors does not develop starting torque.
   (b) Explain working principle of a shaded pole motor. Discuss about its torque-speed characteristic. [8+8]

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