DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

EE 6504 ELECTRICAL MACHINES II

UNIT I

SYNCHRONOUS GENERATOR

PART A

1. Why the stator core is laminated?
2. Define voltage regulation
3. Write the causes of harmonics in the voltage and current waves of electrical machinery.
4. What are conditions for parallel operation of alternators?
5. Write the EMF equation of a three-phase alternator.
6. What are the advantages of salient pole type construction used for Synchronous machines?
7. What do you mean by "single layer" and “double layer" winding?
8. Compare the salient pole rotor and cylindrical pole rotor on stability point of view.
9. Where the damper windings are located? What are their functions?
10. What are the causes of changes in terminal voltage of Alternators when loaded?
11. What is meant by armature reaction in Alternators?
12. What do you mean by synchronous reactance?
13. What is meant by load angle of an Alternator?
14. Name the various methods for predetermining the voltage regulation of 3-phase Alternator.
15. What are the advantages and disadvantages of estimating the voltage regulation of an Alternator by EMF method?
16. Why is the synchronous impedance method of estimating voltage regulation considered as pessimistic method?
17. Why is the MMF method of estimating the voltage regulation considered as the optimistic method?
18. What are the advantages and disadvantages of three dark lamps method of synchronizing?
19. Why synchronous generators are to be constructed with more synchronous reactance and negligible resistance?
20. How does increase in excitation of the Alternator connected to infinite bus-bars affect the operation?

PART –B

1. Describe construction and working of an alternator. (16)
2. i) Derive the emf equation of an alternator.(10)
   ii) Explain pitch factor and distribution factor.(6)

3. Explain the determination of direct(d) and quadrature(q) axis synchronous reactance using slip test.(16)
4. A 3 phase, 6 pole, star-connected alternator revolves at 1000 r.p.m. The stator has 90 slots and 8 conductors per slot. The flux per pole is 0.05 wb (sinusoidally distributed). Calculate the voltage generated by the machine if the winding factor is 0.96.
5. Elaborate the discussion on capability curve with its boundaries of synchronous machine.
6. Discuss the parallel operation of two alternators with identical speed/load characteristics
7. A 3300V, 3phase star connected alternator has a full load current of 100A. On short circuit a field current of 5A was necessary to produce full load current. The emf on open circuit for the same excitation was 900V. The armature resistance was 0.8Ω/phase. Determine the full load voltage regulation for (1)0.8pf lagging (2)0.8pf leading.
8. A 3 phase, 50Hz star connected 2000kA for a certain field excitation. With the same excitation, the open circuit voltage was 900V. The resistance between a pair of terminals was 0.12 Ω. Find the full load regulation at UPF and 0.8pf lagging. Draw the phasor diagrams.
9. What are the methods of determining regulation of alternator? Discuss each briefly.
10. Two alternators working in parallel supply the following loads (i) lighting load of 500kW, (ii) 1000kW at 0.9pf, (iii) 500kW at 0.9pf lead, (iv) 800kW at 0.8 lag. One alternator is supplying 1500kW at 0.95pf lagging. Calculate the load on the other machines.

UNIT II
SYNCHRONOUS MOTOR
PART A

1. What is meant by 'Torque angle'?
2. What is meant by hunting in synchronous motor? Why a synchronous motor is called as constant speed motor?
3. Name the methods of starting synchronous motors Write the applications of synchronous motor.
4. List the inherent disadvantages of synchronous motor?
5. When is a synchronous motor said to receive 100% excitation?
6. What is the effect on speed if the load is increased on a 3 phase synchronous motor?
7. What is the phasor relation between induced emf and terminal voltage of a 3 phase synchronous motor?
8. What are V and inverted V curves of synchronous motor ?
9. What happens when the field current of a synchronous motor is increased beyond the normal value at constant input?
10. Distinguish between synchronous phase modifier and synchronous condenser
11. How the synchronous motor can be used as synchronous condenser?

12. Write important differences between a 3-phase synchronous motor and a 3-phase induction motor.
13. What could be the reasons if a 3-phase synchronous motor fails to start?
14. How does a change of excitation affect its power factor?
15. What is phase swinging and pull out torque?
16. Under which condition a synchronous motor will fail to pull in to step? How the synchronous motor is made self-starting?
17. How will you reverse the direction of rotation of a 3-phase synchronous motor?
18. Give some merits and demerits of synchronous motor
19. In what way synchronous motor is different from other motors?
20. Why a 3-phase synchronous motor will always run at synchronous speed?

PART-B

1. Draw and explain the phasor diagram of a synchronous motor operating at lagging and leading power factor.
2. A 1000 KVA, 11000 V, 3–phase star-connected synchronous motor has an armature resistance and reactance per phase of 3.5 Ω and 40 Ω respectively. Determine the induced emf and angular retardation of the rotor when fully loaded at 0.8 p.f. lagging and 0.8 p.f. leading.
3. (a) Explain the methods of starting synchronous motor against high-torque loads.
   (b) Explain various torques associated with synchronous motor.
4. (a) Draw the equivalent circuit and phasor diagram of a synchronous motor.
   (b) Explain the significance of V and inverted V curves.
5. (a). Explain the working of synchronous motor with different excitations
   (b) List out the main characteristic features of synchronous motor.
6. Derive the mechanical power developed per phase of a synchronous motor.
7. A 3300V, 3 phase synchronous motor running at 1500 rpm has its excitation kept constant corresponding to no-load terminal voltage of 3000V. Determine the power input, power factor and torque developed for an armature current of 250A if the synchronous reactance is 5 Ω per phase and armature resistance is neglected.

8. A 75 kW, 400V, 4 pole, 3 phase, star connected synchronous motor has a resistance and synchronous reactance per phase of 0.04Ω and 0.4 Ω respectively. Compute for full load 0.8pf lead the open circuit emf per phase and gross mechanical power developed. Assume an efficiency of 92.5%.
9. A 6600V, 3 phase, star connected synchronous motor draws a full load current of 80A at 0.8pf leading. The armature resistance is 2.2Ω and reactance of 22Ω per phase. If the stray losses of the machine are 3200W. Find (i) Emf induced (ii)Output power (iii) Efficiency of the machine.

10. A 2000V, 3 phase, 4 pole, star connected synchronous motor runs at 1500rpm. The excitation is constant and corresponding to an open circuit voltage of 2000V. The resistance is negligible in comparison with synchronous reactance of 3.5Ω /ph. For an armature current of 200A.Determine (i) power factor (ii) power input (iii) torque developed.

UNIT III
THREE PHASE INDUCTION MOTOR
PART A

1. State the principle of 3 phase IM?
2. A 50 Hz, 6 pole, 3-phase induction motor runs at 970 rpm. Find slip.
3. Under what condition, the slip in an induction motor is
   (a) Negative
   (b) Greater than one.
4. What are the two fundamental characteristics of a rotating magnetic field?
5. Why an induction motor is called a 'rotating transformer'?
6. Why an induction motor will never run at its synchronous speed? State the condition at which the starting torque developed in a slip-ring induction motor is maximum.
7. State the advantages of skewing?
8. What are the effects of increasing rotor resistance on starting current and starting torque?
9. What is slip and slip speed of an induction motor?
10. What are the advantages of slip-ring I M over cage I M?
11. What are the losses occurring in an IM and on what factors do they depend?
12. What care should be taken at the time of construction to reduce eddy current losses in IM?
13. What is meant by synchronous watts?
14. Name the tests to be conducted for predetermining the performance of 3-phase induction machine.
15. What are the information's obtained from blocked rotor test in a 3-phase I M?
16. What are the advantages and disadvantages of circle diagram method of predetermining the performance of 3 –phase IM?
17. What are the advantages and disadvantages of direct load test for 3 –phase IM?
18. Describe a method to make an induction motor a two-speed motor.
19. Explain why an induction motor, at no-load, operates at very low power factor.
20. What is cogging of induction motor?

PART B

1. Explain the principle of operation of 3-phase induction motor and explain how the rotating magnetic field is produced by three-phase currents.

2. A 50 HP, 6–Pole, 50 Hz, slip ring IM runs at 960 rpm on full load with a rotor current of 40 A. Allow 300 W for copper loss in S.C. and 1200 W for mechanical losses, find R 2 per phase of the 3- phase rotor.
3. Derive an expression for the torque of an induction motor and torque-slip characteristics and obtain the condition for maximum torque.
4. Discuss the different power stages of an induction motor with losses.
5. Write a brief note i) induction generator ii) double cage rotor induction motors.
6. A 6 pole, 50 Hz, 3-Phase, induction motor running on full load develops a useful torque of 160 N m. When the rotor emf makes 120 complete cycle per minute. Calculate the shaft power input. If the mechanical torque lost in friction and that for core loss is 10 N m, complete.
   (1) The copper loss in the rotor windings
   (2) The input the motor.
   (3) The efficiency.
   The total stator loss in given to be 800 W.
7. An 18.65 KW, 4 pole, 50 Hz, 3 phase induction motor has friction and windage losses of 2.5% of the output. Full load slip is 4%. Find for full load
   (1) rotor copper loss,
   (2) rotor input
   (3) shaft torque
   (4) the gross electromagnetic torque.
8. The power input to the rotor of a 3 phase, 50 HZ, 6 pole induction motor is 80 KW. The rotor emf makes 100 complete alternations per minute. Find
   i. Slip
   ii. Motor Speed
   iii. Mechanical power developed
   iv. Rotor copper loss per phase
   v. Rotor resistance per phase if rotor current is 65 A
   vi. Torque developed.
9. (a) A 3300V,10 pole ,50HZ three phase star connected induction motor has slip ring rotor resistance per phase =0.015Ω and standstill reactance per phase =0.25 Ω .If the motor runs at 2.5 percent slip on full load ,find.
      i. Speed of the motor
      ii. Speed at which the torque will be maximum
      iii. The ratio of maximum torque to full load torque.

   (b) A 3 phase, 4 pole, 50 HZ induction motor is running at 1440 rpm. Determine the slip speed and slip.
10. A 100kW, 330V, 50Hz, 3 phase, star connected induction motor has a synchronous speed of 500 rpm. The full load slip is 1.8% and full load power factor 0.85. Stator copper loss is

2440W, iron loss is 3500W, rotational losses is 1200W. Calculate (i) rotor copper loss, (ii) the line current and (iii) the full load efficiency.

UNIT IV
STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR
PART A

1. What is the need of starter for induction motor?
2. Define the term crawling.
3. What are the starting methods used in three phase induction motor?
4. State two advantages of speed control of induction motor by injecting an e.m.f in the rotor circuit.
5. What is the effect of change in input voltage on starting torque of induction motor?
6. What is the magnitude of starting current & torque for induction motor?
7. What is the relationship between staring torque and full load torque of DOL Starter?
8. Name the different types of starters used for induction motor.
9. What are the advantages of primary resistance starter of induction motor?
10. What are the advantages of autotransformer starter?
11. Give the relationship between starting current and full load current of autotransformer starter.
12. Give the relationship between starting torque of induction motor with autotransformer starter and star delta starter.
13. Mention the methods of speed control on stator side of induction motor.
14. Mention the methods of speed control from rotor side of induction motor.
15. Why speed control by changing the applied voltage is simpler? Explain.
16. What are the applications of speed control of induction motor by pole changing method?
17. How the speed control is achieved by changing the number of poles.
18. Mention the three possible methods of speed control of cascaded connection of induction motor.
19. Brief the method of speed control by injecting emf in the rotor circuit.
20. What are the advantages of slip power scheme? Mention types of slip power recovery schemes.

PART B

1. A 15 H.P., three phase, 6 pole, 50 Hz, 400 V, delta connected IM runs at 960 rpm on full load. If it takes 86.4 A on direct starting, find the ratio of starting torque to full-load torque with a star- delta starter. Full load efficiency and power factor are 88% and 0.85 respectively.
2. Explain the following methods of speed control scheme.
   (a) Cascaded connection.

(b) Slip power recovery scheme.

3. Explain the rotor rheostat control of 3 phase slip ring induction motor.
4. With neat diagrams explains the working of any two types of starters used for squirrel cage type 3 phase induction motor.
5. Discuss the various starting methods of induction motors.
6. Explain the various schemes of starting squirrel cage induction motor.
7. Explain the speed control of 3 phase squirrel cage induction motor by pole changing.
8. Explain briefly the various speed control schemes of induction motors.
9. Explain in detail the slip power recovery scheme.
10. Explain the cascade operation of induction motors to obtain variable speed.

UNIT V
SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES
PART A

1. Name the two windings of a single-phase induction motor.
2. Why single phase induction motor is not self starting? Mention any one method of starting.
3. List the applications of single phase induction motor.
4. What are the drawbacks of the presence of backward rotating magnetic field in a single phase induction motor?
5. What are the various methods available for making a single-phase motor self-starting?
6. What could be the reasons if a split-phase motor runs too slow?
7. What could be the reasons that a split-phase motor fails to start and hums loudly?
8. What is the main basic difference between the principle of operation of a 3-phase and single-phase induction motors?
9. Give the main difference in construction of an A.C series motor and a D.C series motor.
10. Differentiate between "Capacitor start" and "Capacitor start capacitor run" induction motors.
11. Why single-phase induction motor has low power factor?
12. What type of single-phase induction motors is employed in high-speed fractional KW applications?
13. Explain why a single-phase induction motor is not self-starting?
14. State the advantages of capacitor-run over capacitor start motor.
15. What is a universal motor? Stale some applications of universal motor.
16. What is the use of shading ring in a shaded pole motor?
17. Stare the advantages of using capacitor start motor over a resistance split phase motor.
18. Give the names of three different types of single-phase induction motor
19. How will you change the direction of rotation of a split phase induction motor?
20. State double revolving field theory.

PART – B

1. Explain with neat diagram the construction and Working of single phase IM.
2. Explain the construction and working principle of
   (a) Linear reluctance motor
   (b) Hysteresis motor.
3. Explain the principle and operation of AC series motor.
4. Give the classification of single phase motors .Explain any two types of single phase induction motors.
5. Develop equivalent circuit of a single phase induction motor ignoring core losses.
6. Explain the working principle of single phase induction motor .Mention its four applications.
7. What is the principle and working of hysteresis motor? Explain briefly.
8. Explain the principle of operation and applications of reluctance motor and stepper motor.
9. Explain the principle of operation and applications of repulsion motor and hysteresis motor.
10. i) Explain about no load and blocked rotor test of single phase induction motor.
    ii) Explain double revolving field theory.