5th Semester Regular/Back Examination: 2024-25
SUBJECT: ELECTRICAL MACHINE-II
BRANCH(S): ELECTRICAL, EEE, EE
Time: 3 Hours
Max Marks: 100
Q.Code: R069
Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1   **Answer the following questions:**   (2 x 10)
  a)   How does a 3-phase alternator differ from a d.c. generator?
  b)   What are the advantages of short-pitched windings in an alternator?
  c)   What is the function of damper winding?
  d)   Why a single-phase induction motor noisier than 3-phase induction motor?
  e)   Why is the starting torque of a resistance split-phase motor not high?
  f)   What is the function of centrifugal starting switch in a single-phase induction motor?
  g)   What do you mean by synchronous speed of a 3-phase induction motor?
  h)   Why is the air gap between the rotor and stator of a 3-phase induction motor kept as small as possible?
  i)   Why does the rotor of the 3-phase induction motor rotate in the same direction as the rotating field?
  j)   What is the difference between squirrel cage rotor and wound rotor?

Part-II

Q2   **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)**   (6 x 8)
  a)   A 500 h.p., 3-phase, 440 V, 50 Hz induction motor has a speed of 950 r.p.m. on full-load. The machine has 6 poles. Calculate the full-load slip. How many cycles will the rotor voltage make per minute?
  b)   Explain different methods of starting of three-phase induction motor.
  c)   Draw and explain the equivalent circuit and phasor diagram of three-phase induction motor.
  d)   A 440 V, 3-phase, 50 Hz, 4-pole, Y-connected induction motor has a full-load speed of 1425 r.p.m.. The rotor has an impedance of (0.4 + j4) Ohm per phase and rotor/stator turn ratio is 0.8. Calculate (i) full-load torque (ii) rotor current (iii) full-load rotor Cu loss.
  e)   Explain the operation of double squirrel cage motor with suitable diagram and equivalent circuit.
  f)   Using double field revolving theory, explain why a single-phase induction motor is not self starting.
  g)   Draw the equivalent circuit of single-phase induction motor and derive the impedance of forward parallel branch and the impedance of backward parallel branch.

h) Calculate the value of the distribution factor for a 3-phase winding of a 4-pole alternator having 36 slots.

i) The stator of a 3-phase alternator has 9 slots per pole and carries a balanced 3-phase, double layer winding. The coils are short-pitched and the coil pitch is 7 slots. Find the distribution factor and pitch factor.

j) A 3-phase, 16-pole synchronous generator has a star connected winding with 144 slots and 10 conductors per slot. The flux per pole is 0.03 Wb, sinusoidally distributed and the speed is 375 r.p.m. Calculate (i) the frequency and (ii) line induced e.m.f.

k) Explain the V curves for synchronous motor with suitable wave forms.

l) Discuss the principle of operation of induction generator with suitable diagram.

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 a) Derive the expression of power developed in salient – pole synchronous generator and draw the power angle characteristics. **(8)**

b) A 3-phase alternator has a direct-axis synchronous reactance of 0.85 p.u. and quadrature-axis synchronous reactance of 0.55 p.u.. Draw the phasor diagram for the alternator when operating on full load at 0.8 p.f. lagging and determine (i) load angle (ii) the no-load p.u. voltage (iii) per unit voltage regulation. Neglect armature resistance. **(8)**

Q4 a) Explain parallel operation of alternators with suitable diagram. What are the advantages of parallel operation of alternators and what are the conditions for paralleling alternator with infinite bus bars? **(8)**

b) A 3000 KVA, 6-pole alternator runs at 1000 r.p.m. in parallel with other machines on 3300 V busbars. The synchronous reactance is 25%. Calculate the synchronizing power for one mechanical degree of displacement and the corresponding synchronizing torque. **(8)**

Q5 Discuss two reaction theory of salient pole synchronous machine and hence explain its phasor diagram. Compare it with cylindrical rotor synchronous machine. **(16)**

Q6 a) Explain the armature reaction of synchronous generator with various cases. **(8)**

b) A 500 KVA, 3-phase, Y-connected alternator has a rated line-to-line voltage of 3300 V. The resistance and synchronous reactance per phase are 0.3 Ω and 4 Ω respectively. Calculate the line value of the e.m.f. generated at full load, 0.8 p.f. lagging. **(8)**