Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: B.Tech
Sub_Code: REL5C003

5th Semester Back Examination: 2025-26
SUBJECT: ELECTRICAL MACHINE-II
BRANCH(S): EEE, ELECTRICAL
Time: 3 Hours
Max Marks: 100
Q.Code: U021

Answer Question No.1 (Part-I) 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) What are the advantages of short-pitched windings in an alternator?
b) What is the function of damper winding?
c) Why a single-phase induction motor noisier than 3-phase induction motor?
d) What do you mean by synchronous speed of a 3-phase induction motor?
e) Why magnetizing current kept small in a 3-phase induction motor?
f) What are the advantages of skewed slots in the squirrel cage motor?
g) Why power factor of a single-phase induction motor is low?
h) What is the function of centrifugal starting switch in a single-phase induction motor?
i) How is the efficiency of an alternator effected by load power factor?
j) How is the sine wave e.m.f. obtained in an alternator?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) A 3-phase, 10 kVA, 400V, 50 Hz, Y-connected alternator supplies the rated load at 0.8 p.f. lag. If armature resistance is 0.5 Ω and synchronous reactance is 10 Ω, find the voltage regulation.
b) Explain the synchronous impedance method of voltage regulation.
c) The effective resistance of a 2200V, 50 Hz, 440 kVA, 3-phase alternator is 0.5Ω. On short circuit, a field current of 40 A gives the full load current of 200A. The voltage on open circuit with same field excitation is 1160V. Calculate (i) synchronous impedance (ii) synchronous reactance.
d) Explain different methods of starting of three-phase induction motor.
e) Draw and explain the equivalent circuit and phasor diagram of three-phase induction motor.
f) Explain the operation of double squirrel cage motor with suitable diagram and equivalent circuit.
g) Using double field revolving theory, explain why a single-phase induction motor is not self-starting.

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

i) A 3-phase, 6000 kW, 4 kV, 180 r.p.m., 50 Hz motor has per phase synchronous reactance of 1.2 Ω. At full load, the torque angle is 20^0 electrical. If the generated back e.m.f./phase is 2.4 kV. Calculate the mechanical power developed. What will be the maximum mechanical power developed?

j) A 10-pole, 3-phase alternator is coupled to an engine running at 600 r.p.m. It supplies 3-phase induction motor which has a full load speed of 1440 r.p.m. Calculate the number of poles and slip of the motor.

k) A 6-pole, 3-phase, 50 Hz induction motor is running at full load with a slip of 4%. The rotor is star connected and its resistance and standstill reactance are 0.25 Ω and 1.5 Ω per phase. The e.m.f. between slip rings is 110 V. Find the rotor current per phase and p.f. assuming the slip rings are short circuited.

l) Derive the maximum torque of the three phase induction motor under running condition.

Part-III

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

Q3 **a)** Derive the equation of developed torque in a three-phase induction motor. **(8)**

b) A 440 V, 3-phase, 50Hz, 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. **(8)**

Q4 Discuss two reaction theory of salient pole synchronous machine and hence explain its phasor diagram. Compare it with cylindrical rotor synchronous machine. **(16)**

Q5 **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)**

Q6 A 2-pole, 240 V, 50 Hz, single-phase induction motor has the following constants referred to the stator: **(16)**

$R_1 = 2.2\ \Omega$; $X_1 = 3.0\ \Omega$; $R_2^1 = 3.8\ \Omega$; $X_2^1 = 2.1\ \Omega$; and $X_m = 86\ \Omega$

Find the stator current and input power when the motor is operating at a full-load speed of 2820 r.p.m. by drawing the equivalent circuit of single-phase induction motor with circuit values.