Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIFTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), DECEMBER 2023
ELECTRICAL AND ELECTRONICS ENGINEERING
(2020 SCHEME)

Course Code : 20EET307

Course Name: Synchronous and Induction Machines

Max. Marks : 100 **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Draw the phasor diagram to represent a cylindrical-rotor alternator with a leading power factor load.
2. List the two characteristics of the type of synchronous generator used in hydroelectric power plants.
3. Define infinite bus bar and describe its properties.
4. List the requirements that must be met to synchronize an alternator with a bus bar.
5. Explain why a synchronous motor cannot initiate its operation independently?
6. A 3Φ induction motor rotor rotates at 1460 rpm when connected across a 50Hz supply. Determine the frequency of rotor induced emf.
7. Explain cogging in induction machines, and methods to eliminate it?
8. Describe the plugging technique for achieving electric braking in an induction motor.
9. Explain the working of shaded-pole induction motor, and mention its typical applications?
10. List out the primary applications of single-phase induction motors.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) List out the different methods to eliminate the presence of harmonics in a synchronous machine's output voltage. (4)

    b) Calculate the rms value of the induced emf per phase and the line voltage of a 10 pole 3 phase 50 Hz, star connected alternator with 2 slots poles per phase and 4 conductors per slot in two layers. The coil span is 5 slots. The flux per pole has a fundamental component of 0.12 Wb and 20% third harmonic. (10)

OR

12. a) Explain the impact of power factor on armature reaction in an alternator using acceptable figures. (5)

b) Determine the useful flux per pole needed to induce a line voltage of 6.6kV in a three phase, four pole, 50 Hz, star connected alternator with 60 slots, two conductors per slot, and short pitched coils, where one coil side is in slot 1 and the other coil side is in slot 13. (9)

MODULE II

13. a) In an alternator a field current of I amp was required to drive rated current on short circuit and a field current of 2.5 times I was required to develop rated voltage on open circuit. Using emf method evaluate the voltage regulation of the alternator when delivering rated current at 0.8 pf lag. Assume armature resistance is 20% of synchronous impedance. (You can assume any value for rated voltage and rated current). (9)

b) Explain the significance of the synchronous reactance and armature resistance in determining the voltage regulation of a synchronous generator. (5)

OR

14. a) Enumerate the different techniques for synchronizing alternators and elaborate on one of those methods. (5)

b) The following test results are obtained on a 6.6kV alternator.

Open circuit voltage(V)	3100	4900	6600	7500	8300
Field current(A)	16	25	37.5	50	70

(9)

A field current of 20A is found necessary to circulate full load current on short circuit of the armature. By Ampere Turn method calculate the full load regulation at 0.8 pf lag. Neglect resistance and leakage reactance.

MODULE III

15. a) A 25hp, 230V,50Hz, 4 pole star connected synchronous motor has an armature resistance per phase of 0.12Ω and a synchronous reactance per phase of 1.6Ω. The angle between rotor and stator field is 10^0. The generated voltage per phase is 110V. Find i) armature current ii) synchronous impedance angle iii) power factor angle and iv) total power input to the motor. (7)

b) Derive the condition for pull out torque during starting and running conditions of a 3 phase squirrel cage induction motor and draw its torque-slip characteristics. (7)

OR

16. a) Depicit the phasor diagram and equivalent circuit of an induction motor under load conditions. (8)

b) Describe the concept of an inverted V curve in synchronous motor operation. Compare it with the regular V curve. (6)

MODULE IV

17. a) A 400V ,40hp,50Hz,4 pole, delta connected induction motor gave the following test data.

No load test	400V	20A	1200W
Blocked rotor test	100V	45A	280W

(14)

Draw the circle diagram and determine

I. The line current and power factor for rated output
II. Maximum output
III. Maximum torque
IV. Full load efficiency

Assume stator resistance is equal to 0.4Ω/ph.

OR

18. a) Describe the operation of a double cage induction motor using a clear diagram, and depict its torque slip characteristics. (8)

b) Provide an illustrated diagram demonstrating the application of a star-delta starter for commencing a three-phase squirrel cage induction motor. (6)

MODULE V

19. a) Distinguish between grid-connected and self-excited induction generators. (8)

b) Describe the double field revolving theory of a 1 Φ induction motor. (6)

OR

20. a) Elucidate the distinctions that exist between synchronous and induction generators. (8)

b) Describe the operation of a split phase single phase induction motor with illustration. (6)

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