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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIFTH SEMESTER B.TECH DEGREE EXAMINATION (Regular), DECEMBER 2022
ELECTRICAL AND ELECTRONICS ENGINEERING
(2020 SCHEME)

Course Code : 20EET307

Course Name: Synchronous and Induction Machines

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

Provide two graph sheets

PART A

(Answer all questions. Each question carries 3 marks)

1. The armature flux aids the main field flux when an alternator operates ZPF at leading.' Justify the statement.
2. From fundamentals, develop the emf equation of an alternator.
3. Draw the phasor diagram of a salient pole alternator under lagging power factor based on Blondel's two reaction theory.
4. Why EMF method is called pessimistic method and justify.
5. Describe any one method of starting a 3-phase synchronous motor.
6. A 6 pole, 3-phase induction motor runs at 960 rpm on a 50 Hz supply. Determine:
   (i) Synchronous speed, (ii) Frequency of rotor emf.
7. Explain the phenomenon of crawling in induction motors. How can it be eliminated?
8. Describe the stator voltage speed control technique in 3-phase induction motors.
9. Explain the double field revolving theory in a single phase induction motor.
10. Describe the principle of operation of a shaded pole motor.

PART B

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

MODULE I

11. a) Compare salient pole and cylindrical rotor types of alternators. (7)
    b) 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 span is 7 slots. Determine the distribution factor and the pitch factor. (7)

OR

12. a) Describe the methods adopted for suppressing harmonics in alternators. (5)

b) A 3-phase, 4 pole, 50 Hz, star-connected alternator has 60 slots on its stator periphery with 4 conductors per slot. The air gap flux per pole is sinusoidally distributed and equals 0.943 Wb. The phase spread is 60° and the coils are short-pitched by 3 slots. Calculate: (i) the emf generated per phase, and (ii) the line induced emf. (9)

MODULE II

13. a) Describe with the help of a neat circuit diagram, the dark lamp method of synchronizing an alternator. (7)

b) Elucidate how the direct-axis and quadrature-axis synchronous reactance of a salient pole alternator can be determined experimentally. (7)

OR

14. Determine the full-load voltage regulation by MMF method of a 50 kVA, 500 V, three-phase, 50 Hz alternator at 0.8 p.f. lagging having the following test data. The effective armature resistance is 0.2 Ω. (14)

Field current I_f (A)	5	10	15	20	25	30
EMF (V)	125	250	370	480	566	640
Short-circuit armature current I_{SC} (A)	73	146	220	-	-	-

15. a) Draw and explain briefly the power flow diagram of an induction motor. (4)

b) A 500 V, 50 Hz, 6 pole, 3-phase induction motor gives an output of 20 kW at 950 rpm with a power factor of 0.8. The stator losses amount to 1500 W and the mechanical losses are 1000 W. Calculate: (i) slip, (ii) rotor copper losses, (iii) power input to the stator, and (iv) line current. (10)

OR

16. a) Enumerate the various applications of a synchronous motor. (5)

b) Describe with the help of phasor diagrams, the effect of excitation on the armature current and power factor of a synchronous motor and hence infer the V curves and inverted V curves. (9)

MODULE IV

17. Draw the circle diagram for a 15 kW, 400 V, 50 Hz, 3-phase, star-connected induction motor based on the following test data: (14)
No load test (Line values): 400 V, 9 A, power factor = 0.2
Blocked rotor test (Line values): 200 V, 50 A, power factor = 0.4

Assume that the copper losses are equally divided between the stator and rotor.
Determine: (i) line current on full load, (ii) full load power factor, and (iii) maximum power output.

OR

18. With the help of neat diagrams, describe the different braking techniques of induction motors. (14)

MODULE V

19. a) Elucidate why the single-phase induction motor is not self-starting. (5)

b) With the help of neat circuit diagram and phasor diagram, explain the working of capacitor start type single-phase induction motor. Mention any two applications. (9)

OR

20. Explain the principle of operation of an induction generator. Contrast between the grid-connected and self-excited modes of operation with the aid of neat figures. (14)

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