Code : 031403

B.Tech 4th Semester Exam., 2019

ELECTRICAL MACHINES—II

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Choose the correct answer (any *seven*) : 2×7=14

(a) The pitch factor for a two-thirds short-pitch coil is

(i) 0·5

(ii) 0·66

(iii) 0·866

(iv) 0·707

(b) The speed regulation of a synchronous motor is

(i) unity

(ii) zero

(iii) infinity

(iv) always less than one

(c) The armature flux helps the main field flux when the load power factor is

(i) unity

(ii) zero-lagging

(iii) 0·8 lagging

(iv) zero-leading

(d) In alternators, damper windings are used to

(i) reduce eddy-current loss

(ii) prevent hunting

(iii) make the rotor dynamically balanced

(iv) reduce armature reaction

(e) In a split-phase motor, the running winding should have

(i) high resistance and low inductance

(ii) high resistance and high inductance

(iii) low resistance and high inductance

(iv) low resistance and low inductance

(f) In a capacitor start and run motors, the function of the running capacitor in series with the auxiliary winding is to

(i) improve power factor

(ii) reduce fluctuations in torque

(iii) increase overload capacity

(iv) improve torque

(g) In case the field of a synchronous motor is under excited, the power factor will be

(i) leading

(ii) lagging

(iii) zero

(iv) unity

(h) When the excitation of an unloaded salient pole synchronous motor gets disconnected

(i) the motor will burn

(ii) the motor will stop

(iii) the motor will run as a reluctance motor at the same speed

(iv) the motor will run as a reluctance motor at a lower speed

(i) The back e.m.f. setup in the stator of a synchronous motor will depend on

(i) rotor speed only

(ii) rotor excitation only

(iii) rotor excitation and speed

(iv) coupling angle, rotor speed and excitation

(j) If two mechanically coupled alternators deliver power at 50 Hz and 60 Hz respectively, then the highest speed of alternators will be

(i) 1200 r.p.m.

(ii) 1500 r.p.m.

(iii) 600 r.p.m.

(iv) 300 r.p.m.

2. (a) Explain the armature reaction phenomenon in a cylindrical rotor synchronous generator by drawing the space and time phasor diagram when operating at an internal power factor of (i) zero-lagging and (ii) zero-leading. 7

(b) For a salient pole, synchronous machine P_1 and P_2 are the maximum values of electromagnetic power and

reluctance power respectively. Show that the load angle δ, at which the resultant power is maximum can be obtained from the relation

$$\cos\delta = \frac{-P_1 \pm \sqrt{P_1^2 + 32\,P_2^2}}{8P_2}$$ 7

3. *(a)* A 6-pole, 3-phase, 50 Hz alternator has 12 slots per pole and 4 conductors per slot. The winding is five-sixth pitch and the flux per pole is 1·5 Wb. The armature coils are all connected in series with star connection. Calculate the induced e.m.f. per phase. 7

(b) Define the various modes of excitation of synchronous generator. Also draw the V curve and inverted V curve for such system. 7

4. *(a)* Discuss Blondel's two-reaction theory of salient pole synchronous machine. 7

(b) The speed regulations of two 800 kW alternators *A* and *B* running in parallel are 100% to 104% and 100% to 105% from full-load to no-load respectively. How will the two alternators share a load of 1000 kW? 7

5. *(a)* State the need for parallel operation of alternators. What are the conditions for parallel operation of three-phase alternators? 6

(b) A 500-kVA, 1·1-kV, 50 Hz, three-phase star-connected alternator has an effective armature resistance of 0·2 ohm per phase. The synchronous reactance per phase is 1·5 ohm. Find the full-load voltage regulation at *(i)* 0·8 lagging power factor and *(ii)* 0·8 leading power factor. Draw phasor diagram in each case. 8

6. *(a)* Explain why a synchronous motor does not have starting torque. Explain one method of starting a synchronous motor. 6

(b) An industrial plant has a load of 800 kW at a power factor of 0·8 lagging. It is desired to install a synchronous motor to deliver a load of 200 kW and also serve as a synchronous condenser to improve the overall power factor of the plant to 0·92. Determine the kVA rating of the synchronous motor and its power factor. Assume that the motor has an efficiency of 90 percent. 8

7. (a) Explain how the stationary, pulsating m.m.f. wave of a single-phase induction motor can be considered as equivalent to two equal but oppositely rotating m.m.f. waves. Also explain why the forward flux wave is several times greater than the backward flux wave at normal rotor speed. 7

(b) A 230-V, 4-pole, 50 Hz capacitor start a single-phase induction motor has the following constants and losses :

$r_1 = 2 \cdot 10\ \Omega$, $r_2 = 4\ \Omega$, $X_m = 70\ \Omega$,

$x_1 = 3\ \Omega$, $x_2 = 3\ \Omega$

Core loss = 48 watts, Friction and windage loss = 20 watts

For a slip of 0·05, compute the stator current, pf, power output, torque and efficiency when this motor is running at rated voltage and frequency with its auxiliary winding open. 7

8. (a) Draw the complete torque-speed characteristics of a single-phase induction motor when no auxiliary winding is provided on the stator. Show how the torque speed characteristics is modified when an auxiliary winding is provided. 8

(b) Mention the conditions necessary for the production of rotating magnet field with the help of stationary windings. 6

9. (a) What is a universal motor? How is it different from a d.c. series motor? Mention its applications. 7

(b) Explain the construction and working principles of a repulsion motor. How is a repulsion-induction motor different from a repulsion motor? 7

★ ★ ★