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15116

3 Hours / 100 Marks

Seat No.

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- Instructions :** (1) All Questions are *compulsory*.
 (2) Illustrate your answers with neat sketches wherever necessary.
 (3) Figures to the right indicate full marks.
 (4) Assume suitable data, if necessary.
 (5) Use of Non-programmable Electronic Pocket Calculator is permissible.
 (6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. (A) Attempt any **THREE** of the following : **12**
- (a) State the effects of change in supply voltage on torque-slip characteristics of 3-phase induction motor.
- (b) State the function of following parts of an induction motor (i) Slip-rings, (ii) Fan, (iii) Brushes and (iv) Frame.
- (c) (i) State the necessity of starter for three-phase induction motor.
 (ii) Write the names of starters used for 3-phase squirrel cage induction motor.
- (d) Define the following terms and write their mathematical expression :
 (i) Pitch Factor and
 (ii) Distribution Factor related to the winding of alternators
- (B) Attempt any **ONE** of the following : **6**
- (a) Draw and explain how star-delta starter is used for reducing the starting current of a 3-phase induction motor.
- (b) Describe the principle of operation of an induction generator. Draw its torque-speed characteristic.

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2. Attempt any FOUR of the following : 16

- (a) Compare squirrel cage and slip-ring induction motor on the basis of :
 (i) Starting torque (ii) Power factor (iii) Speed control and
 (iv) Applications.
- (b) Explain why three phase induction motor is called as asynchronous motor. Also give the formulae for rotor induced emf and frequency of rotor currents.
- (c) Compare salient pole rotor and smooth cylindrical rotor alternator on the basis of : (i) Operating speed (ii) Rotor construction (iii) Ratio of core length to bore diameter and (iv) Applications.
- (d) Draw the phasor diagram of loaded alternator when load is capacitive and also write the equation of no load, induced emf.
- (e) A motor is to be operated from 230 V, 50 Hz single phase A.C. and 220 V D.C. supply. Identify the above motor and describe its working principle with neat sketch.
- (f) Practically if D.C. series motor has to be supplied with single phase A.C., what modification and refinements will have to be done on D.C. series motor ?

3. Attempt any FOUR of the following : 16

- (a) Draw and explain torque-slip characteristics of three phase induction motor.
- (b) Describe with the help of curves the effect of variation of a rotor circuit resistance on the torque-slip characteristics of an induction motor.
- (c) Derive the e.m.f. equation of a three phase alternator from first principle.
- (d) An 400 V, 125 kVA, 3-phase, star connected alternator has open-circuit characteristics as under :

Field Current (A)	0	10	20	30	40	50	60
Open Circuit emf (V)	0	140	250	340	400	460	520

- Short circuit characteristics of the alternator is a straight line passing through origin and it is found that the S.C. current is equal to the full load current when I_f is 20 A. Determine full load regulation of the alternator by Z_s method at the following p.f. : (i) 0.8 lagging and (ii) 0.8 leading. Assume R_a is 0.15Ω .
- (e) "Single phase induction motor is not self starting." Justify the statement by double field revolving theory.

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4. (A) Attempt any THREE of the following : 12

- (a) A 440 V, 6-pole, 3-phase, 50 Hz induction motor develops an output of 15 kW at 950 r.p.m. If the input power factor is 0.86 lagging, mechanical losses are 730 W and the stator losses 1500 W. Find (i) The Slip (ii) The rotor copper losses (iii) The motor input and (iv) The line current.
- (b) Write any four significances of a rotor resistance starter.
- (c) Find the no-load line voltage of a star connected 3-phase, 6-pole alternator which runs at 1200 rpm, having flux per pole of 0.1 Wb sinusoidally distributed. Its stator has 54 slots having double layer winding. Each coil has 8 turns and the coil is chorded by one slot.
- (d) Explain the need of parallel operation of Alternators.

(B) Attempt any ONE of the following : 6

- (a) Describe with the help of necessary graphs and phasor diagram, the procedure to calculate voltage regulation of a 3-phase alternator by synchronous impedance method.
- (b) (i) Write the formulae for X_s , Z_s of an alternator.
(ii) Explain the effect of armature reaction at various p.f. of loads of an alternator. Draw suitable wave-forms showing the effects.

5. Attempt any FOUR of the following : 16

- (a) Draw and explain power flow diagram of three phase induction motor.
- (b) Prove that rotor copper loss in induction motor is slip times rotor input.
- (c) Describe three-lamp method of synchronising an alternator with the bus-bar.
- (d) What are the conditions to be fulfilled when two alternators are to be connected in parallel ?
- (e) Describe the construction and working principle of Line as Induction Motor. (LIM)
- (f) Describe the working principle of permanent magnet stepper motor.

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6. Attempt any FOUR of the following :**16**

- (a) Discuss about the split-phasing principle used in the starting of single phase induction motor. Explain the construction and working of resistance split phase induction motor in detail.
 - (b) State one application of the following special machines :
 - (i) Universal motor
 - (ii) Linear Induction motor
 - (iii) Induction Generator and
 - (iv) Stepper motor
 - (c) State four advantages of rotating field over rotating armature of a 3-phase alternator.
 - (d) Describe with neat sketch, the principle of operation of single phase shaded pole induction motor.
 - (e) Compare resistance split phase motor with capacitor split phase motor on the basis of (i) Output, (ii) Starting torque, (iii) Power factor and (iv) Applications.
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