# 17511

**16172**

**3 Hours / 100 Marks** Seat No. | | | | | | | | |

*Instructions* – (1) All Questions are *Compulsory*.

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

(8) Use of Steam tables, logarithmic, Mollier's chart is permitted.

**Marks**

**1.** a) **Attempt any <u>THREE</u> of the following:** **12**

(i) Explain, why 3-phase induction motor never run on synchronous speed.

(ii) With the help of torque-speed or slip characteristic, explain the effect of rotor circuit resistance on different torques of an induction motor.

(iii) With the help of a neat labelled diagram, explain construction and working of a auto-transformer starter used for starting 3-phase induction motor.

(iv) With the help of a neat labelled diagram, explain construction and working principle of a 3-phase alternator.

**Marks**

b) **Attempt any ONE of the following:** **6**

(i) State different methods used for controlling speed of a 3-phase induction motor and explain any one method of speed control in detail.

(ii) Draw a schematic diagram of an a.c. series motor. How the direction of rotation and speed of this motor can be changed. Give any two applications of this motor.

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

a) With neat sketches explain how rotating magnetic field is produced in a 3-phase induction motor.

b) A 3-$\phi$, 50 Hz, 4 pole, induction motor operated at a slip of 4%, calculate:

(i) Speed of motor

(ii) Frequency of rotor emf.

If the rotor has resistance of 1 ohm and standstill reactance of 4 ohms per phase, calculate rotor power factor at:

(i) Stand still

(ii) At a speed of 1440 r.p.m.

c) A 3-phase, 6 pole, star connected alternator revolves at 1000 r.p.m. The stator has 90 slots and 8 conductors per slot. The flux per pole is 0.05 wb (sinusoidally distributed) calculate the value of phase voltage and line voltage generated by the machine, if the winding factor is 0.96.

d) Explain the factors which affects terminal voltage of an alternator.

e) What is an universal motor? Comment briefly on it's construction features and speed-torque characteristic, state any two applications of this motor.

f) With neat diagram explain working principle of a permanent magnet stepper motor.

**Marks**

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

a) Compare cage and wound rotor type 3-phase induction motor with reference to following:

(i) construction

(ii) performance

(iii) speed control

(iv) applications

b) A 3-phase induction motor has a synchronous speed of 250 r.p.m. and 4% slip at full load. The rotor has resistance of 0.02 ohms per phase and stand still leakage reactance of 0.15 ohms per phase. Calculate:

(i) The speed at which maximum torque is developed.

(ii) The ratio of maximum to full load torque.

(iii) The ratio of maximum to starting torque.

(iv) What value should the resistance per phase have so that the starting torque is half the maximum torque?

c) Derive the emf. equation of a 3-$\phi$ alternator.

d) Explain the essential difference between cylindrical (smooth) and salient pole rotor used in large alternators. What type of rotor would you expect to find in:

(i) A-2-pole machine

(ii) A-12-pole machine

e) Why a single phase induction motor doesn't have a self starting torque? Explain with the help of a double field revolting theory.

**Marks**

**4.** a) **Attempt any <u>THREE</u> of the following:** **12**

(i) A 500 V, 3-phase, 50 Hz, induction motor develops an out-put of 15 kW at 950 r.p.m. If the input power factor is 0.86 lagging, mechanical losses are 730 W and stator losses are 500 W. Find:

1) The slip

2) The rotor cu loss

3) The rotor input

4) The line current

(ii) With the help of mathematical expression state why it is necessary to use starter in 3-phase induction motor.

(iii) With the help of a neat circuit diagram, explain the procedure to calculate voltage regulation of a 3-phase alternator by synchronous impedance method.

(iv) Why it is necessary to run alternators in parallel? Explain.

b) **Attempt any <u>ONE</u> of the following:** **6**

(i) Define voltage regulation of an alternator. State and explain the factors on which voltage regulation depends.

(ii) A 3-phase, star connected alternator rated at 1600 kVA 13500 V; The armature resistance and synchronous reactance are 1.5 ohms and 30 ohms respectively per phase - calculate percentage voltage regulation for a load of 1280 kW at a power factor:

(i) 0.8 leading

(ii) unity

**Marks**

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

a) A 20 H.P., 3-phase, 50 Hz, 4 pole induction motor has a full load slip of 4%. The friction and windages losses are 500 watts. Calculate the rotor copper loss and rotor speed.

b) State different methods used for measurement slip of a 3-phase induction motor and explain any one method in detail.

c) State various methods of synchronizing 3-phase alternators and explain any one method in detail.

d) Two alternators A and B operate in parallel and supply a load of 8 MW at 0-8 power factor lagging. The power out put of A is adjusted to 5000 kW by changing its steam supply and its power factor adjusted to 0-9 lagging by changing its excitation. Find power factor of alternator B.

e) Explain the principle of operation of a linear induction motor.

f) What is an induction generator? State it's principle of operation.

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

a) State any two applications of the following motors:

(i) Shaded pole induction motor

(ii) Capacitor start induction run motor

(iii) Resistance start induction run motor

(iv) Capacitor start capacitor run motor

b) With a neat circuit diagram, explain construction and working principle of a capacitor start induction run 1-phase induction motor.

c) With a neat labelled diagram, explain principle of operation of a shaded pole single phase induction motor.

d) Define armature reaction in an alternator. Discuss the effect of lagging power factor load on armature reaction.

e) State any two applications of the following motors:

(i) A.C. servomotor

(ii) D.C. servomotor

(iii) Variable reluctance stepper motor

(iv) Permanent magnet stepper motor

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