Q1 (16 marks)

Differentiate between squirrel cage and wound rotor motor of the three phase a.c. induction motor in respect of the following: (16)

(a) Rotor construction

(b) Torque characteristic

(c) Speed variation.

AC Motor

Q2 (16 marks)

With reference to an emergency source of electrical power in cargo ships: (16)

(a) Describe a typical power source.

(b) Give a typical list of essential services, which must be supplied simultaneously.

(c) Explain how the emergency installation can be periodically tested.

Batteries & E'mcy power supplies

Q3 (16 marks)

The direct online start of squirrel cage motor is used for most electrical drives on A.C. powered ships. Describe with sketches as necessary one method of overcoming each of the following Problems:

(a) High starting current. (8)

(b) Low starting torque. (8)

AC Motor

Q4 (16 marks)

(a) (i) Discuss the various hazards and problems which are associated with electric cable Insulation in the event of fire.

(ii) Suggest remedies for these problems. (8)

(b) State how the spread of fire may be reduced by the method used for installing electric cables. (8)

Q5 (16 marks)

(a) What are the causes of overheating of an induction motor? (4)

(b) What preventive measures are provided against damage to an induction motor in installed condition? (3)

(c) What is the purpose of 'fuse back up protection' provided to an induction motor? (3)

(d) How does an induction motor develop torque? (3)

(e) What is the condition to be satisfied for achieving maximum running torque in an induction motor? (3)

AC Motor

Q6 (16 marks)

(a) Explain the significance of the root-mean-square value of an alternating current or voltage waveform. Define the form factor of such a wave form. (6)

(b) A total load of 8000 kW at 0.8 power factor is supplied by two alternators in parallel. One alternator supplies 6000 kW at 0.9 power factor. Find the kVA rating of the other alternator and the power factor. (10)

Calculations

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Q7 (16 marks)

(a) By means of a schematic circuit diagram illustrate the peak rectifier. If the supply voltage is v(t) = Vm Sin wt, what is the voltage across the load resistor? (6)

(b) A battery-charging circuit is shown below in Fig. The forward resistance of the diode can be considered negligible and the reverse resistance infinite. The internal resistance of the battery is negligible. Calculate the necessary value of the variable resistance R so that the battery charging current is 1.0 A. (10)

Calculations

Q8 (16 marks)

(a) Why is it important to maintain high efficiency of operation and low values of voltage regulation for power transformers? (6)

(b) A 100 KVA transformer has 400 turns on the primary and 80 turns on the secondary. The primary and secondary resistances are 0.3 Ω and 0.01 Ω respectively and the corresponding leakage reactances are 1.1 Ω and 0.035 Ω respectively. The supply voltage is 2200 V. Calculate: (10)

(i) The equivalent impedance referred to the primary circuit.

(ii) The voltage regulation and secondary terminal voltage for full load having a power factor of (a) 0.8 lagging and (b) 0.8 leading.

Transformer

Calculations

Q9 (16 marks)

(a) List the factors that determine the starting torque of the three-phase induction motor. How does this torque generally compare with the value of the rated torque? (6)

(b) The low-voltage release of an A.C. motor-starter consists of a solenoid into which an iron plunger is drawn against a spring. The resistance of the solenoid is 35 ohms. When connected to a 220 V, 50 Hz, A.C. supply the current taken is at first 2 A, and when the plunger is drawn into the “full-in” position the current falls to 0.7 A. Calculate the inductance of the solenoid for both positions of the plunger and the maximum value of flux-linkages in weber-turns for the “full-in” position of the plunger. (10)

Calculations

Q10 (16 marks)

(a) With the aid of delta and star connection diagrams, state the basic equation from which the delta-star and star-delta conversion equation can be derived. (6)

(b) Three batteries A, B, and C have their negative terminals connected together. Between the positive terminals of A and B there is a resistor of 0.5 ohm and between B and C there is a resistor of 0.3 ohm.

Specifications of the three batteries are given below: (10)

Battery A 105 V, Internal resistance 0.25 ohm

Battery B 100 V, Internal resistance 0.2 ohm

Battery C 95 V, Internal resistance 0.25 ohm

Determine the current values in the two resistors and the power dissipated by them.

Calculations