

Full Marks: 70

Time: 3 hrs

- (i) Use separate answer script for each half
- (ii) The questions are of equal value
- (iii) Answer any six questions taking three from each half
- (iv) **Two marks** reserved for neatness in each half

FIRST HALF

1. a) What is a 'stranded' conductor? What is the necessity of stranding? (1 + 2)
b) What are the distinguishing features of a 'Hochstadter' cable? Draw the cross-sectional view of such a cable? (2 + 2)
c) For a single-core 150 A cable, a 3-layer stranded conductor is used with a space factor of 0.9. Each strand has a diameter of 1 mm. Find out the current density in the conductor. (4)

2. a) What are the desirable characteristics of mining cables? Where do pliable armoured cables find application in mines? (2 + 2)
b) For a 6.6 KV substation, if the existing cable is replaced with a cable whose overall diameter is same but the conductor diameter is increased, what happens to the value of the maximum dielectric stress? Explain your answer with relevant mathematical deduction. (5)
c) What is XLPE? (2)

3. a) Why are 'flameproof' equipment necessary in mines? (3)
b) What are the components of an 'intrinsically safe' circuit? How do you classify 'field devices'? (3 + 2)
c) "For dc motors, field control is applied for getting speeds higher than rated speed". Correct or justify. (3)

4. a) A 220 V, 24 A, 1000 rpm separately excited dc motor is being driven by a chopper supplied from 230 V dc source. Calculate the duty cycle for a speed of 500 rpm and 1.2 times the rated torque if the chopping frequency is 500 Hz. (Armature resistance of motor is 2 Ω) (5)
b) Explain why stator voltage control of induction motors is suitable for speed control of fan and pump drives only. (3)
c) What is static rotor resistance control of induction motors? (3)

5. a) Draw a schematic diagram for Ward-Leonard-Ilgner control. How do you replace this with a power electronic circuit? What advantages are obtained with this replacement? (2 + 2 + 2)
b) If the slip of a 4-pole 50 Hz. 3-phase induction motor is 4%, find its rotor speed. (2)
c) Draw the torque-speed characteristic of an induction motor drive under V/f control showing clearly the different modes of operation. (3)

SECOND HALF

6

- a) Explain 'radial' and 'ring main' systems of distribution.
- b) A two-wire DC distributor cable AB, fed at one end, is 1.8 km long. It supplies concentrated loads of 50A, 100A and 150A, situated at 400 meters, 1000 meters and 1600 meters respectively from the feeding point A. Each conductor has a resistance of 0.05 ohms per 1000 meters. Calculate the voltage at each point if a voltage of 400V is maintained at the feeding point A.

[5+6=11]

7

- a) A two-wire AC distributor OAB, fed at one end, has a load of 100A at B and 50A at A, both at power factor of 0.8 lagging. The impedance of section OA of the feeder is $(0.05 + j0.1) \Omega$ and that of section AB is $(0.1 + j0.15) \Omega$. If the voltage at the far end B of the feeder is 400V, find the voltage at A and at the feeding end O.
- b) What properties should an electrical conductor possess if it is to be used for an overhead distribution system?

[6+5=11]

8

- a) What are the problems of poor power factor in an AC radial distribution system?
- b) Name some electrical equipment used for power factor correction in practice.
- c) Describe the functions and duties of a contactor and an isolator used as switchgear devices in electrical power systems?

[4+2+5=11]

9

- a) What is a circuit breaker?
- b) Classify circuit breakers based on different types of arc-quenching medium.
- c) What are the main components of a circuit breaker?

[4+3+4=11]

10 Draw a single line diagram of a typical electrical power distribution system of a Under-ground colliery with proper labels and describe the system.

[11]