

BINDURA UNIVERSITY OF SCIENCE EDUCATION
FACULTY OF SCIENCE AND ENGINEERING

AEH 508

Department Of Engineering and Physics
Bachelor of Science (Honours) in Agricultural Engineering
Electrification for Agriculture

3 HOURS (100 MARKS)

MAR 2024

INSTRUCTIONS

Answer any **FOUR** questions. Each question carries 25 marks.

Question 1

- a. Briefly describe the following terms as used in electricity transmission systems:
- i. A system network/grid [2 marks]
 - ii. Feeder [2 marks]
 - iii. Service mains. [2 marks]
- b. Describe three factors that determine the number of feeders on the ring-main distribution (R.M.D) system. [6 marks]
- c. If a 3-phase, 4-wire system is to be used for lighting, compare the amount of copper required with that needed for a 2-wire D.C. system with same line voltage. Assume the same losses and balanced load and the neutral is one half the cross-section of one of the respective outers. [13 marks]

Question 2

- a. i. Explain the 'Corona effect' on current carrying conductors. [6 marks]
ii. Briefly describe five disadvantages of the 'Corona effect' on conductors when it is not kept in constant check. [10 marks]
- b. Calculate the distance over which a load of 15000 kW at 0.85 p.f. can be delivered by a 3-phase transmission line having conductors of steel-cored aluminium each of resistance $0.905 \Omega/\text{km}$. It is given that the voltage at the receiving end is to be 132 kV and the loss in transmission is 7.5% of the load. [9 marks]

Question 3

- a. Briefly explain four distinct merits of adopting a need-based energy management system in agriculture. [8 marks]
- b. A transmission line with a span of 200 metres between level supports has a conductor of cross-sectional area 1.29 cm^2 . If the conductor weighs 1170 kg/km and has a breaking stress of 4218 kg/cm^2 , calculate:
- i. the sag for a factor of safety of 5 allowing a wind pressure of 122 kg per m^2 of projected area, [12 marks]
 - ii. the vertical sag. [5 marks]

Question 4

- a. Explain three effects of using insulation on current carrying conductors. [6 marks]
- b. Discuss the process and importance of energy auditing in agricultural production systems. [12 marks]

- c. A motor has to perform the following duty cycle: 100 H.P. for 10 min; No Load for 5 min; 60 H.P. for 8 min and No Load for 4 min which is repeated infinitely. Determine the suitable size of continuously rated motor. [7 marks]

Question 5

- a. Highlight five merits and demerits of electric motor group drive systems. [10 marks]
- b. If a 40-kW, 440-V, d.c. shunt motor, with armature resistance $R_a = 0.1 \Omega$, full-load $I_a = 100$ A, full-load speed of 600 rpm, is braked by plugging, calculate:
- i. the value of resistance that must be placed in series with the armature circuit to limit the initial braking current to 150 A, [5 marks]
 - ii. the braking torque and [6 marks]
 - iii. the torque when motor speed falls to 360 rpm. [4 marks]

Question 6

- a. Describe how illumination occurs as a result of radiation from a hot body. [7 marks]
- b. If the average luminous output of an 80-W fluorescent lamp 1.5 metre in length and 3.5 cm diameter is 3300 lumens, calculate its average brightness. [6 marks]
- c. A corridor is lighted by 4 lamps spaced 10 m apart and suspended at a height of 5 m above the centre line of the floor. If each lamp gives 200 C.P. in all directions below the horizontal, find the illumination at the point on the floor mid-way between the second and third lamps. [12 marks]

End of paper.