071306T4EEN

Electrical Enginering (Power Option) Level 6

ENG/CU/PO/CR/02/6

Install Electrical Power Lines

July/August 2023

Time: 3 Hours

TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

WRITTEN ASSESSMENT

3 HOURS

INSTRUCTIONS TO CANDIDATE:

*This paper consists of **TWO** sections: **A** and **B**.*

*Answer **ALL** questions in sections A and B in the answer booklet provided.*

Marks for each question are indicated in brackets

Do not write on this question paper.

*Answer the questions in **English.***

This paper consists of three (3) printed pages.

Candidate should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A (40 MARKS)

Answer ALL the questions in this section.

1. Outline **four** considerations for high voltage transmission lines. (4 marks)
2. State **four** effects of vibration on the transmission lines. (4 marks)
3. List any four elements of a high-voltage transmission line. (4 marks)
4. State **four** causes of high voltage surges in transmission lines. (4 marks)
5. Describe the following types of electrical transmission power lines: (4 marks)
   a) Short transmission lines;
   b) Long transmission lines.
6. Explain **two** advantages of Miniature Circuit breakers (MCBs) over fuses. (4 marks)
7. Define the following terms as used in protective devices of electrical machines. (4marks)
   a) Current rating;
   b) Fusing factor.
8. Overhead conductor depends on tensions, list any **four**. (4 marks)
9. State and explain **two** essential requirements of a switch gear. (4 marks)
10. State **four** ways of reducing corona effect in a transmission lines. (4 marks)

SECTION B (60 MARKS)

*Answer any **three** questions in this section.*

11. (a) Outline **four** properties of line support in transmission lines. (4 marks)

(b) Discuss **three** types of insulators used in overhead transmission lines. (6 marks)

(c) A 3-phase transmission line is being supported by three-disc insulators. The potentials across top unit (i.e., near to the tower) and middle unit are 8 kV and 11 kV respectively. Calculate the:

i. ratio of capacitance between pin and earth to the self-capacitance of each unit;
ii. line voltage;
iii. string efficiency. (10 marks)

12. (a) Discuss the following terms as applied to transmission lines:

i. Voltage regulation
ii. Transmission efficiency (4 marks)

(b) With aid of equations differentiate between Positive and Negative phase sequence (4 marks)

(c) Using vector diagrams explain the **three** commonly used methods of medium transmissions lines. (12 marks)

13. (a) Explain the **three** constants of a power transmission line. (6 marks)

(b) Define 'skin effect' and list four factors it depends on. (6 marks)

(c) The phase voltages across a certain unbalanced three-phase load are given as; $E_R = 176 - j132$, $E_Y = -128 - j96$ and $E_B = -160 + j100$. determine the positive, negative and zero-sequence components for the above voltages. (8 marks)

14. (a) Explain three types of tests carried out in electrical transmission power lines. (6 marks)

(b) Explain 'corona effect'. (3 marks)

(c) A three-phase, 220 kV, 50 Hz, 100 km long overhead line consists of three stranded aluminium conductors spaced 5 m apart in equilateral formation. The surrounding air is at a temperature of 27^{o}C and a pressure of 740 mm of mercury. The breakdown strength of air is 3000 V/mm (Max.). Determine:

(i) The disruptive critical voltage;
(ii) The visual critical voltage;
(iii) The corona power loss of the line.

Assume the conductor diameter of 21 mm, the irregularity factor of 0.9 for the disruptive critical voltage and 0.8 for the visual critical voltage. (11 marks)

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