2521/205
2601/205
ELECTRICAL POWER GENERATION,
TRANSMISSION AND PROTECTION
Oct./Nov. 2018
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING
(POWER OPTION)

ELECTRICAL POWER GENERATION, TRANSMISSION AND PROTECTION

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
 Answer booklet,
 Non programmable scientific calculator.
This paper consists of TWO sections; A and B.
Answer any THREE questions from section A and TWO questions from section B.
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.

This paper consists of 5 printed pages.

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

SECTION A: ELECTRICAL POWER GENERATION AND TRANSMISSION

*Answer any **THREE** questions from this section.*

1. (a) State **two** advantages and **two** disadvantages of a gas power station over hydro-electric power station. (4 marks)

    (b) Describe the following plant auxiliaries of a diesel power station:

    (i) air intake system;
    (ii) exhaust system;
    (iii) cooling system.

    (6 marks)

    (c) Draw a labelled diagram of a nuclear reactor. (4 marks)

    (d) Water for a hydro-electric power station is obtained from a reservoir with a head of 125 metres. If the hydraulic efficiency is 0.88 and electrical efficiency is 0.93; calculate the electrical energy generated per hour per cubic meter of water.

    (6 marks)

2. (a) Define the following terms as used in power supply systems:

    (i) diversity factor;
    (ii) average demand factor.

    (2 marks)

    (b) (i) Explain the term 'most economical cross-sectional area' of a conductor with regards to power supply.
    (ii) State **two** limitations of Kelvin's law in economics of power supply.

    (6 marks)

    (c) A generating station has two 60 MW units each running for 8000 hours in a year and one unit of 30 MW running of 1200 hours in one year.
    The station output is 600 x 10^6 kWh per year. Determine the:
    (i) Station load factor;
    (ii) utilization factor;
    N.B: Assume maximum demand equals installed capacity of the station. (9 marks)

    (d) State **three** causes of wear and disintegration of a power plant. (3 marks)

3. (a) State **three** types of insulating materials used in underground cables. (3 marks)

    (b) Draw a labelled diagram of a three phase oil filled underground cable having an outer lead sheath. (8 marks)

(c)   The conductor of a 60 kV, single core lead-sheathed underground cable has a diameter of 40 mm and internal diameter of the lead sheath is 50 mm. The insulation has a relative permittivity of 4.
Determine the:

    (i)   maximum and minimum values of dielectric stress;
    (ii)   optimum value of conductor radius and the associated dielectric stress.

                                              (9 marks)

4.   (a)   Name **three** types of conductor materials used for construction of overhead transmission lines.

                                              (3 marks)

    (b)   With reference to insulators, describe the following tests:

        (i)   puncture test;
        (ii)   porosity test;
        (iii) mechanical test.

                                                (6 marks)

    (c)   Figure 1 shows arrangement of capacitances for a string of five insulators used to suspend one conductor line of 33 kV three phase overhead line. Determine the voltage across unit.

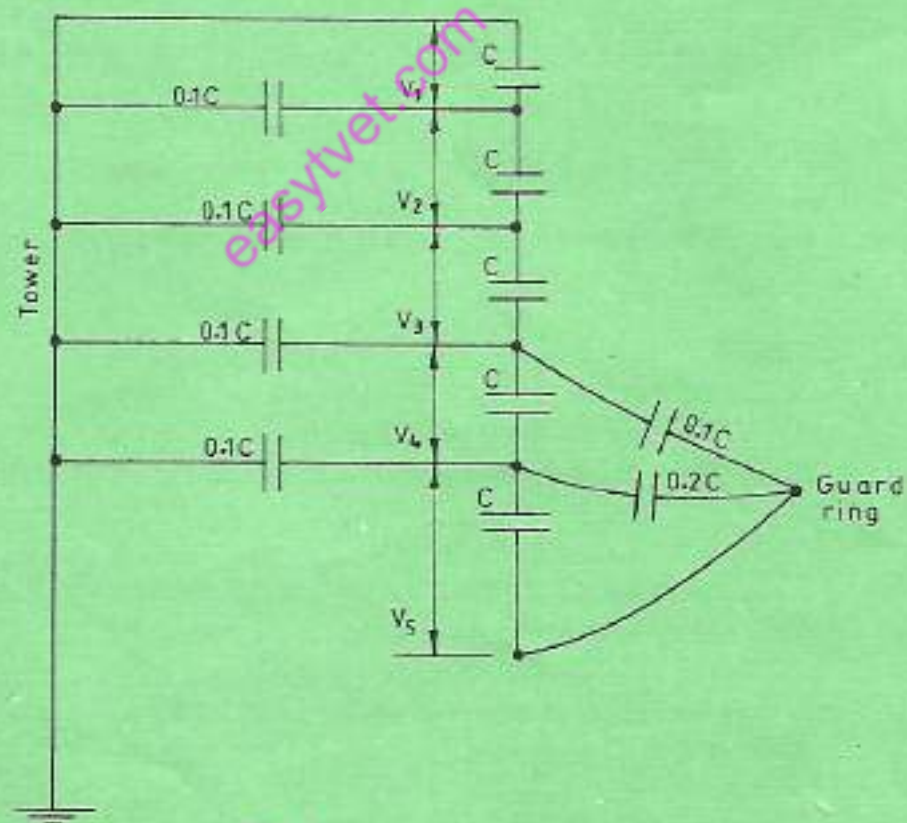   (11 marks)

Fig. 1

5. (a) State **three** elements of an excitation system. (3 marks)

(b) Define the term short-circuit KVA with respect to transmission lines. (2 marks)

(c) A three phase transmission line operating at 66 kV is connected through 11/66 kV, 1200 KVA transformer with 6% reactance to a generating station bus bar. The generator is rated 2000 KVA with 8% reactance.

(i) Sketch the equivalent line diagram.
(ii) Calculate the short circuit current at the high voltage terminals of the transformer. (13 marks)

(d) List **two** advantages of high rapturing capacity fuses over rewirable type. (2 marks)

SECTION B: ELECTRICAL POWER PROTECTION

*Answer any **TWO** questions from this section.*

6. (a) (i) Define the term 'wiring system'.

(ii) Explain **three** factors considered when selecting a particular wiring system. (8 marks)

(b) Outline **six** steps considered when selecting cable size using a given load data. (6 marks)

(c) (i) Name **two** types of utility services in buildings. (2 marks)

(ii) Draw a wiring diagram of four socket outlets connected in ring. Include a spur. (4 marks)

7. (a) State:

(i) **two** types of flame proof equipment.
(ii) **four** precautions observed when erecting conduits in flame proof areas. (6 marks)

(b) (i) With the aid of a diagram, explain the cosine law of illumination.
(ii) Derive the expression for the law in (b)(i). (6 marks)

(c) A lamp having mean spherical candle of 600 is suspended at a height of 8 m. Calculate:

(i) total flux of light;
(ii) illumination just below the lamp. (5 marks)

(d)   With aid of a labelled diagram, describe the operation of an arc-lamp.   (3 marks)

8.   (a)   State **two** areas of application of lightning protection systems.   (2 marks)

(b)   Explain, with aid of a diagram the meaning of the term "zone of protection" when referring to a single vertical lightning conductor.   (6 marks)

(c)   Name **three** components of a lightning protection system.   (3 marks)

(d)   (i)   With aid of a diagram, describe the cathodic sacrificial anode protection system.

(ii)   State **three** construction materials which cause corrosion.   (9 marks)

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