2521/205
2601/205
ELECTRICAL POWER GENERATION,
TRANSMISSION AND PROTECTION
June/July 2019
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (POWER OPTION)

MODULE II

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 any TWO questions from section B in the answer booklet provided.
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.

Turn over

SECTION A: ELECTRICAL POWER GENERATION AND TRANSMISSION

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

1. (a) State **two** disadvantages and **one** advantage of diesel power station over geothermal power station. (3 marks)

    (b) Kenya expects to start generating electricity from nuclear power by the year 2027. Explain **three** factors considered when selecting the site for a nuclear power station. (6 marks)

    (c) Draw a labelled diagram showing the various penstock protective devices as used in hydro-electric power plant. (5 marks)

    (d) A diesel power station has fuel consumption of 0.26 kg per kwh. The calorific value of fuel used is 12,000 KCal/kg. Determine the overall efficiency of generation of power. (6 marks)

2. (a) With reference to power generation, differentiate between fixed and running costs. (4 marks)

    (b) State **four** advantages of interconnected grid system in power supply systems. (4 marks)

    (c) Explain the effect of diversity factor on cost of generation of electric power. (3 marks)

    (d) A power generating station has a maximum demand of 40 MW, load factor of 55% and plant capacity factor of 40%. Determine the:

    (i) daily energy produced;
    (ii) reserve capacity of the plant.

    (9 marks)

3. (a) Name **three** types of faults that occur in underground cables. (3 marks)

    (b) With aid of a diagram, describe how to locate ground fault using the varley loop test. (8 marks)

(c)   Data for a 20 kV, 50 Hz, single core lead sheathed paper insulated cable is as follows:

- Conductor diameter 30 mm
- Internal diameter of lead sheath 60 mm
- Conductor length 1.8 km
- Insulation permittivity is 3
- Dielectric loss angle 0.0017 radians

Determine the:

(i)   capacitance;
(ii)   total dielectric loss;
(iii)   maximum stress.   (9 marks)

4.   (a)   Name **three** line supports used in overhead transmission lines.   (3 marks)

(b)   With the aid of a diagram, show that the expression for inductance L of a single phase overhead line is given by:

$$L = \frac{2l}{10^7} \log_e \frac{d}{r} H$$

Where: d = spacing between conductors
        r = radius of the conductor
        l = length of the transmission line

(10 marks)

(c)   (i)   State **three** equipment used for improving power factor.

(ii)   A sub-station power transformer supplies 400 kW at 0.6 power factor lagging.

(I)   Sketch the phasor diagram and

(II)   Calculate the KVAr rating of loss-free static capacitors required to raise the power factor to 0.95 lagging.
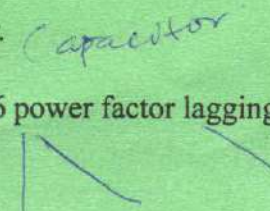
(7 marks)

5.   (a)   State **four** types of electrical short circuits in three phase four wire electrical power systems.   (4 marks)

(b)   (i)   State **three** advantages of sulphur hexafluoride gas circuit breakers over air blast circuit breakers.

(ii)   Draw a diagram showing the parts of a high rapturing capacity fuse.

(8 marks)

(c)   A three phase, 30 MVA, 12 kV alternator has internal reactance of 6% and negligible resistance. Calculate the external percentage reactance to be connected in series with the alternator so that a steady current on short-circuit does not exceed six times the full load current.   (5 marks)

(d)   Explain the function of the following elements in an excitation system:

    (i)   regulator;
    (ii)   exciter;
    (iii) power system stabilizer.   (3 marks)

SECTION B: ELECTRICAL BUILDING SERVICES AND PROTECTION

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

6.   (a)   State **three** factors that affect cable rating.   (3 marks)

     (b)   A two-core copper cable supplies current to a 220 V single phase load of 10 kW at 0.8 power factor lagging. The cable is 0.06 km long and the conductor resistance is 0.032 Ω. The resistivity of copper is 17.5 $\mu\Omega$ mm.

           Determine the:

           (i)   cross-sectional area of each conductor;

           (ii)   voltage drop in the cable.   (5 marks)

     (c)   Draw the wiring diagram for a final circuit serving three lights each controlled by a single pole switch.   (6 marks)

     (d)   State **six** types of building structures.   (6 marks)

7.   (a)   Define the following terms as used in illumination and state the units in each case:

           (i)   luminous flux;
           (ii)   illuminance.   (4 marks)

     (b)   With aid of a diagram, describe the operation of low pressure sodium vapour lamp.   (7 marks)

(c) (i)   Define Division O area with reference to hazardous areas.   (1 mark)

     (ii) An electrical workshop measuring 25 m x 12 m is to be illuminated by 150 watt lamps. Illumination required is 60 lux and lamp efficiency is 16.25 lm/W. If the depreciation factor is 1.3 and utilization factor is 0.5, calculate the number of lamps to be used.   (8 marks)

8. (a)   Describe the process of electrolytic corrosion and state how it can be prevented.   (3 marks)

    (b)   Explain **three** ways of preventing corrosion in electrical installations.   (6 marks)

    (c)   With aid of a diagram, describe the operation of cathodic impressed current.   (6 marks)

    (d) (i)   Describe the following parts of a lighting protection system:

              (I)   earth termination;
              (II)   earth electrode.

         (ii) Outline **three** effects of lightning strokes.   (5 marks)

THIS IS THE LAST PRINTED PAGE.