

2521/205

2601/205

**ELECTRICAL POWER GENERATION,
TRANSMISSION AND PROTECTION**

June/ July 2016

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 Electronic 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 shown.

Candidates should answer the questions in English.

This paper consists of 4 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

Answer **THREE** questions from this section.

1. (a) State **three** advantages of high power factor. (3 marks)
- (b) (i) Define the following terms with regard to electrical power systems:
- I. plant factor;
 - II. utilization factor.
- (4 marks)
- (ii) A 150 MW power station delivers 150 MW for two hours, 50 MW for six hours and is shut down for the rest of the day. It is also shut down for maintenance for 45 days each year. Determine the annual load factor of the station. (9 marks)
- (c) Explain **four** reasons for drawing daily load curves for generating stations. (4 marks)
2. (a) State **two** advantages and **two** disadvantages of a hydroelectric power station. (4 marks)
- (b) With aid of a labelled schematic diagram, describe the operation of a hydro-electric power station. (10 marks)
- (c) Water for a hydroelectric station is obtained from a reservoir with a head of 120 metres. The hydraulic and electrical efficiencies are 0.86 and 0.90 respectively. Determine the electrical energy generated per hour cubic meter of water. (6 marks)
- $120 \times 0.86 \times 0.90$
3. (a) State **three** advantages of direct laying of underground cables. (3 marks)
- (b) (i) With aid of diagrams, derive the expression for dielectric stress in a single core underground cable.
- (ii) A 33 kV single core cable has a conductor diameter of 10 mm and a sheath of 40 mm. Determine the maximum and minimum stress in the insulation. (15 marks)
- (c) State **two** types of conductor materials used in electric power transmission lines. (2 marks)



4. (a) With aid of a graph, explain Kelvin's law. (5 marks)
- (b) A two-conductor cable 1000 metres long is required to supply a constant current of 300 A throughout the year. The cost of cable including installation is Ksh. $(1200a + 1200)$ per metre where 'a' is the cross-sectional area of the conductor in cm^2 . The cost of electrical energy is Ksh. 10 per kWh. The resistivity of the conductor is $1.73 \mu\Omega \text{ cm}$ and interest and depreciation charges are 12%. Determine the most economical conductor size. (12 marks)
- (c) List **three** properties of line supports for overhead line conductors. (3 marks)

5. (a) (i) State **two** functions of excitation systems. (7 marks)
- (ii) Draw a labelled block diagram of an excitation system.

(b) Figure 1 shows a single line diagram of a three phase system. The percentage reactances of each alternator is based on its own capacity:

- (i) Determine the short circuit current that will flow into a complete three-phase short circuit at F;
- (ii) Sketch the equivalent reactance diagram. (13 marks)

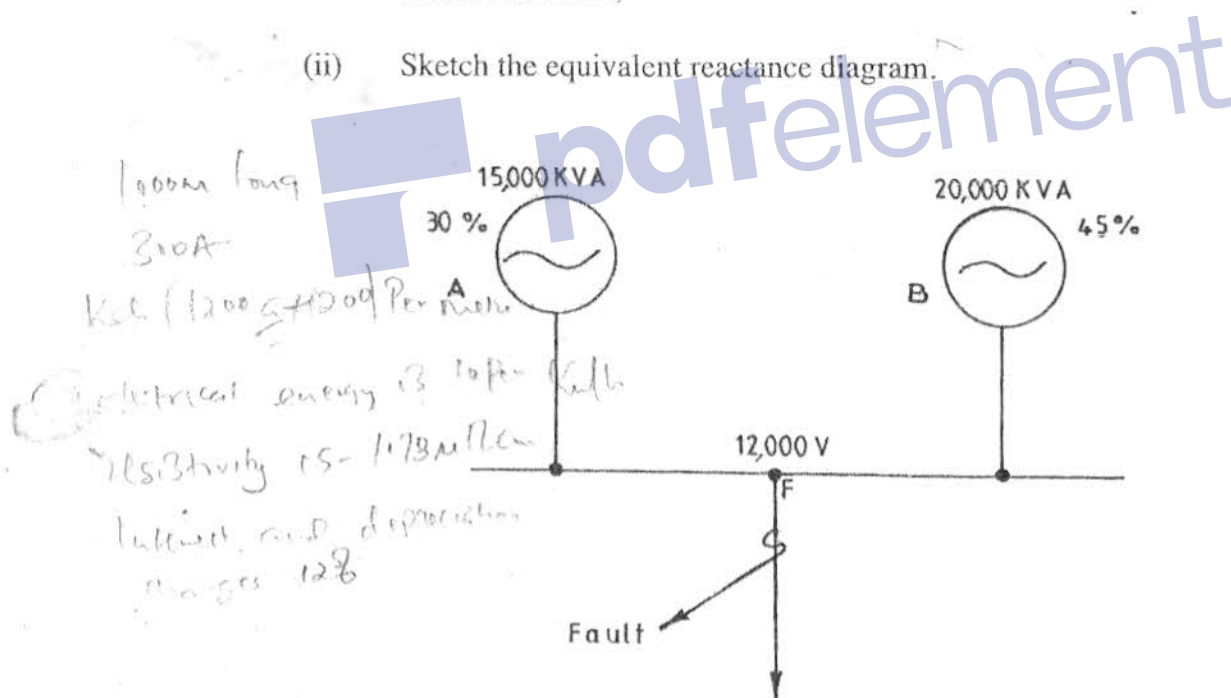
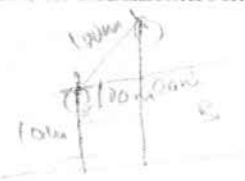


Fig. 1

SECTION B

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

6. (a) Define the following terms as used in illumination:
- (i) luminous flux;
 - (ii) luminous intensity.
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- (4 marks)
- (b) Two lamps A and B of 100 candela and 200 candela respectively are situated 100 m apart. The height of A above the ground level is 10 m and that of B is 20 m.
- (i) Sketch the arrangement.
 - (ii) Determine the total illumination at the centre of the line joining the two lamps.
- (14 marks)
- (c) State **two** rating factors used to determine the current carrying capacity of a cable.
- (2 marks)
7. (a) State **three** methods of earthing.
- (3 marks)
- (b) Draw a labelled construction diagram of high rupturing capacity fuse.
- (7 marks)
- (c) State **two** factors which determine whether lighting protection is required.
- (2 marks)
- (d) With aid of a diagram, explain the cathodic impressed current protection in electrical installations.
- (8 marks)
8. (a) State **three**:
- (i) hazards regarding electrical installations;
 - (ii) types of cables used in wiring in division 1 area.
- (6 marks)
- (b) Describe the IEE regulations for caravan installations.
- (5 marks)
- (c) Explain the need for each of the following building works in an electrical installation:
- (i) manhole;
 - (ii) chases.
- (3 marks)
- (d) State **three** precautions to be observed while carrying out each of the services in (c).
- (6 marks)

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