2521/205
2601/205
ELECTRICAL POWER GENERATION,
TRANSMISSION AND PROTECTION
June/July 2023
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;*
- *drawing instruments.*

*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

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

1. (a) State **four** hydraulic structures of a Hydro-electric power station. (4 marks)

(b) Explain each of the following factors considered when selecting the site of a steam power plant:

(i) Supply of fuel;
(ii) Availability of water;
(iii) Distance from populated area.

(6 marks)

(c) A generating station has the following daily load cycle:

Time (Hours)	0-6	6-10	10-12	12-16	16-20	20 - 24
Load (MW)	50	60	70	60	80	50

(i) Draw the daily load curve;
(ii) Determine the:
(I) Units general per day
(II) Load factor (10 marks)

2. (a) State any **three** insulating materials used in underground cables. (3 marks)

(b) Describe each of the following parts of an underground cable:

(i) Metal sheath;
(ii) Bedding;
(iii) Armouring.

(6 marks)

(c) A single core cable for use on 33 kV, 50 Hz system has a conductor of cross sectional area 1.131 m^2 and the internal diameter of sheath is 4 cm. The permittivity of the dialectric used in the cable is 5. Determine the:
(i) maximum electrostatic stress in the cable;
(ii) minimum electrostatic stress in the cable;
(iii) capacitance of the cable per km. (11 marks)

(i) properties of overhead line conductor materials;
(ii) overhead line conductor materials. (4 marks)

(b) Describe each of the following overhead line insulator tests:

(i) Dry flash-over test;
(ii) Temperature test. (6 marks)

(c) A string of three insulators is used to suspend one conductor of a 33 kV, three-phase overhead line. The air capacitance between each cap/pin junction and the tower is 15% of the self-capacitance of each insulator. Determine the:

(i) voltage across each unit;
(ii) string efficiency. (10 marks)

4. (a) (i) Draw a labeled diagram of the brushless excitation systems.
(ii) State two merits of the system in (i). (10 marks)

(b) A three phase synchronous motor is used to improve the power factor of a 680 kW load from 0.85 to 0.96 lagging. The motor has total load of 120kW.
(i) Draw the phasor diagram;
(ii) Determine the kVA rating of the motor. (10 marks)

5. (a) With reference to causes of short circuits in a power system, distinguish between internal effects and external effects. (4 marks)

(b) Describe the operation of a low oil circuit breaker. (5 marks)

(c) A 3-phase transmission line operating at 11 kV and having a resistance of 5Ω is connected to generating station bus-bars trough 5MVA step-up transformer having a reactance of 5%. The bus-bars are supplied by a 10 MVA alternator having 10% reactance. If a symmetrical fault occurs at the load end of the transmission line determine short-circuit KVA. (11 marks)

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

6. (a) State **three** IEE regulations requirements regarding installations in:
   (i) damp areas;
   (ii) caravan sites. (6 marks)

   (b) List **two** methods of ensuring static electricity produced in hospitals is not dangerous. (2 marks)

   (c) With the aid of a labeled diagram, describe the sacrificial anode method used in prevention of corrosion. (6 marks)

   (d) With the aid of a labeled diagram, describe the construction and operation of a high pressure mercury vapour lamp. (6 marks)

7. (a) With the aid of a labeled diagram, describe the parts of a lightning protection system. (10 marks)

   (b) State:

   (i) **two** types of flame proof equipment
   (ii) **three** precautions to be observed during erection of conduits in flame proof areas. (5 marks)

   (c) (i) Explain stroboscopic effect.
   (ii) List **three** methods of minimizing the effect (i) with reference to fluorescent lamps. (5 marks)

8. (a) Define each of the following terms as used in illumination:

   (i) Candela;
   (ii) Lumen.

   (4 marks)

   (b) A light source of intensity of 450 cd is mounted 3 m directly above a point on a horizontal bench. Determine the illumination at:

   (i) a point just below the light sources;
   (ii) a second point on the bench which is 4 m from the first point. (6 marks)

(d) Draw a wiring diagram of three socket outlets connected in ring including a spur.
(5 marks)

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