

2521/204 2602/204
2601/204 2603/204
**ENGINEERING DRAWING AND
CIRCUIT ANALYSIS**
June/July 2019
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING
(POWER OPTION)
(TELECOMMUNICATION OPTION)
(INSTRUMENTATION OPTION)
MODULE II

ENGINEERING DRAWING AND CIRCUIT ANALYSIS
3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet

Mathematical tables/ non programmable scientific calculator;

Drawing instruments;

Drawing paper size A2;

Computer installed with Auto-CAD software, electronic CAD software and a printer.

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

*Answer any **THREE** questions in section **A** and any **TWO** questions in section **B** in the answer booklet and drawing papers provided.*

All questions carry equal marks. All working must be shown.

Maximum marks for each part of a question are as indicated.

Candidates should answer the questions in English.

This paper consists of 7 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: CIRCUIT ANALYSIS

Answer **THREE** questions from this section.

1.

- (a) Describe the construction features of each of the following types of rotors of three phase induction motors:

- (i) squirrel cage rotor;
- (ii) wound rotor.

(6 marks)

- (b) (i) Sketch the torque-slip characteristic curve for a 3-phase induction motor.
- (ii) A 50 Hz 6 pole 3-phase induction motor has a full load slip of 4%. The rotor resistance and stand still reactance are 0.01Ω and 0.1Ω respectively.

Determine the speed at which maximum torque occurs.

(5 marks)

- (c) Draw the following three phase transformer winding connections:

- (i) Delta-delta;
- (ii) Delta-star.

(4 marks)

- (d) (i) Name **three** types of D.C motors.

- (ii) An 8-pole lap wound D.C generator rotated at 300 rpm is required to generate 250 V. The useful flux per pole is 0.05 Wb. If the armature has 100 slots, determine the number of conductors per slot.

(5 marks)

2.

- (a) Explain:

- (i) why synchronous motors are not self starting;
- (ii) how the condition in (a)(i) is overcome.

(5 marks)

- (b) (i) State **three** conditions to be considered when synchronizing three phase machine to an existing supply.

- (ii) Draw a labelled circuit diagram of 'lamps-dark' method of synchronization.

(9 marks)

- (c) A 3-phase synchronous motor has 8 poles and operates from a 415 V, 50 Hz supply. It takes a line current of 100 A at 0.8 p.f leading. Neglecting losses, determine the:
- motor speed;
 - torque development by the motor.
- (4 marks)
- (d) A stepper motor with a step angle of 20° has a stepping frequency of 200 steps per second. Determine the motor speed. (2 marks)
3. (a) Draw a labelled circuit diagram of a capacitor start single phase induction motor. (6 marks)
- (b) Outline **four** merits of the motor in (a). (4 marks)
- (c) Draw a labelled circuit diagram of a two wattmeter method use to measure power in a three phase star balanced load. (4 marks)
- (d) Two wattmeters connected to a three phase motor indicate the total power input 0.5 10 Kw. The power factor is 0.6. Determine the readings of each wattmeter. (6 marks)
4. (a) Explain **four** conditions which affect the maximum power transferred from the source to the load in electric circuits. (4 marks)
- (b) A DC circuit consists of a resistor connected in series with a $22 \mu F$ capacitor. The time constant is 60 ms and supply voltage is 24 V. Determine the:
- resistance;
 - voltage across capacitor at 3 ms;
 - voltage across resistor at 4.5 ms.
- (6 marks)
- (c) Figure 1 shows an electric circuit. Using Thevenin's Theorem:

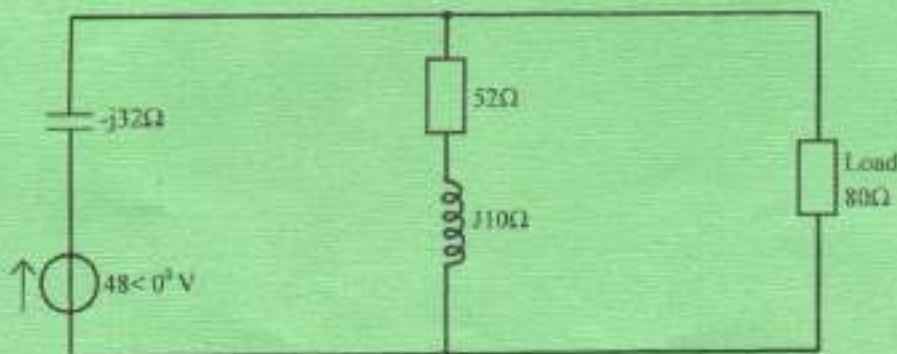


Fig. 1

(i) determine the:

- (I) open circuit voltage;
- (II) equivalent impedance.

(ii) Draw the Thevenin's equivalent circuit. Determine the current flowing.

(10 marks)

5. (a) Describe two-port network.

(2 marks)

(b) Figure 2 shows a two-port identical T-network in cascade between a d.c generator and load. The current flowing into the first stage is $\frac{1}{8}$ of its initial value. Determine the:

- (i) resistances R_1 and R_2 ;
- (ii) currents in each stage.

(10 marks)

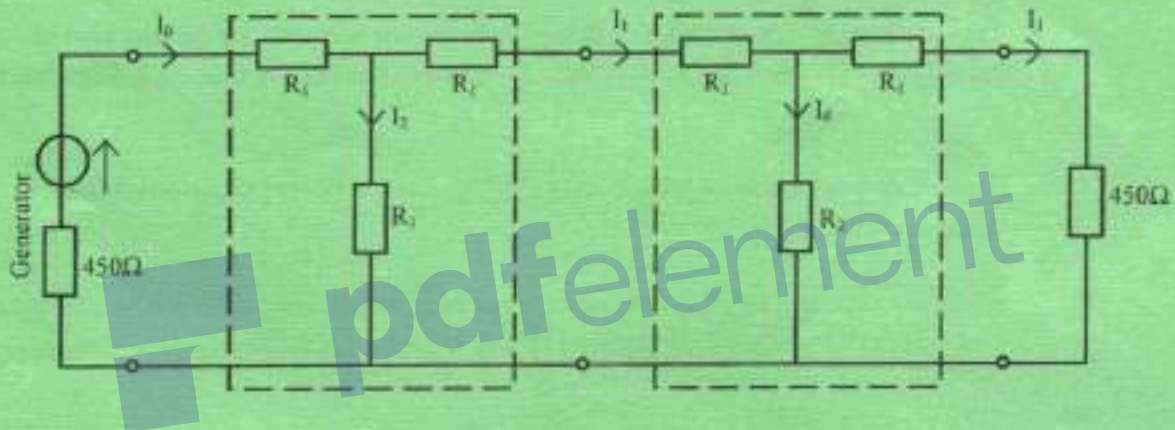


Fig. 2

(c) A complex current is represented by $i = 13 \sin \omega t + 6 \sin 4\omega t + 4 \sin 7\omega t$ amperes. Determine the:

- (i) rms value;
- (ii) mean value;
- (iii) form factor.

(8 marks)

SECTION B: ENGINEERING DRAWING

Answer any *TWO* questions from this section.

6. (a) Figure 3 shows a printed circuit diagram of an electronic circuit. Draw the equivalent schematic diagram. (10 marks)

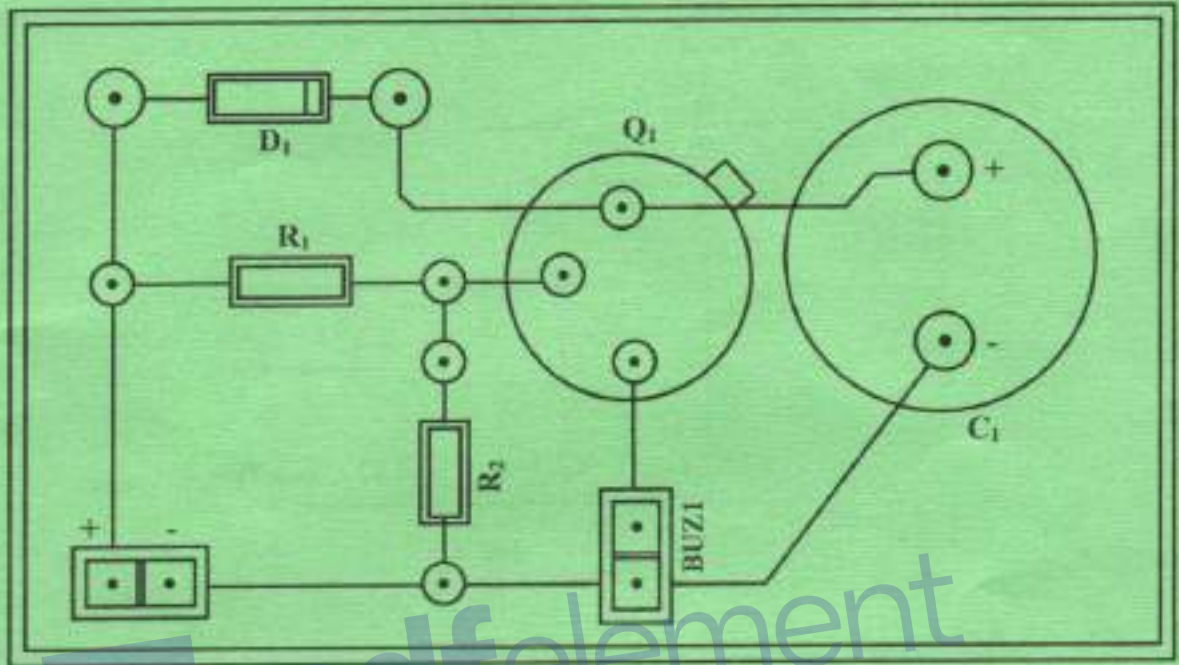


Fig. 3

where D1 is a diode
R1 and R2 are fixed carbon resistors.
Q1 is NPN transistor
C1 is an electrolytic capacitor
Buz1 is a buzzer.

- (b) Figure 4 shows control circuit of star-delta starter for a three phase induction motor. Draw the equivalent ladder logic diagram. (10 marks)

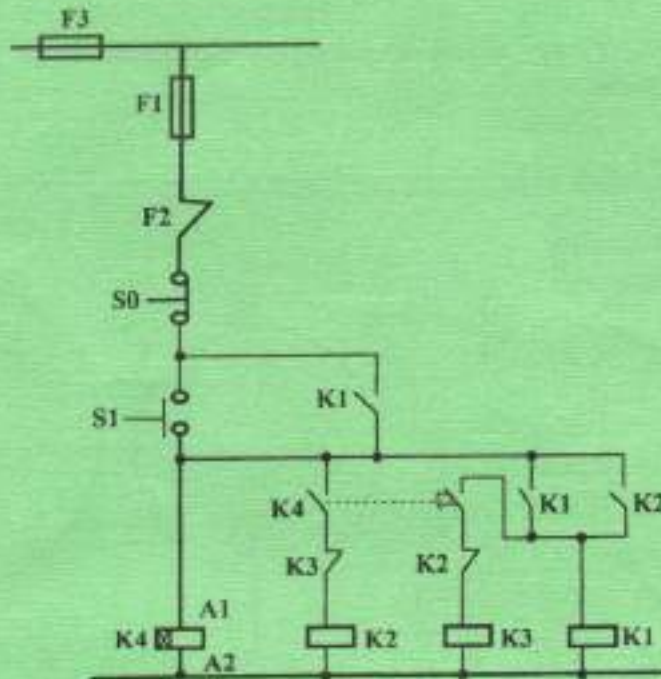


Fig. 4

where F1 and F3 are protection fuses

F2 is overload relay

S0 is stop button

S1 is start button

K1 is line contactor

K2 is start contactor

K3 is delta contactor

K4 is start-delta timer relay

7. (a) Construct a rectangle given the length of the diagonal as 80 mm and width as 30 mm. (5 marks)
- (b) Construct a regular octagon inside a circle of diameter 80 mm using a ruler and compass only. (5 marks)
- (c) Construct a parabola given distance between the focus and directrix as 20 mm. (5 marks)
- (d) Construct a common tangent between two circles of diameters 60 mm and 30 mm with their centres 100 mm apart. (5 marks)

- (10 marks)



- (10 marks)



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