2521/204 2602/204
2601/204 2603/204
ENGINEERING DRAWING AND
CIRCUIT ANALYSIS
Oct./Nov. 2018
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

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INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Mathematical tables/ non programmable scientific calculator;
Drawing instruments;
Drawing paper size A3;
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 6 printed pages.

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

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SECTION A: CIRCUIT ANALYSIS

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

1. (a) State **three** advantages of three phase systems over single phase systems. (3 marks)

(b) Show that the total power in a star or delta connected load is given by,

$P = \sqrt{3}\, V_L I_L \cos\phi$ watts. (7 marks)

(c) Two wattmeters are connected to measure the input power to a balanced three phase load. The wattmeter readings are 16 kW and 8 kW. Determine the:

(i) total input power;

(ii) load power factor.

(6 marks)

(d) Draw a circuit diagram of a three phase transformer connected in star-delta. Show the line and phase voltages. (4 marks)

2. (a) State 'Thevenins theorem'. (2 marks)

(b) **Figure** 1 shows a d.c circuit. Determine the:

(i) total circuit impedance;

(ii) supply current I;

(iii) current flowing through the inductor.

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(7 marks)

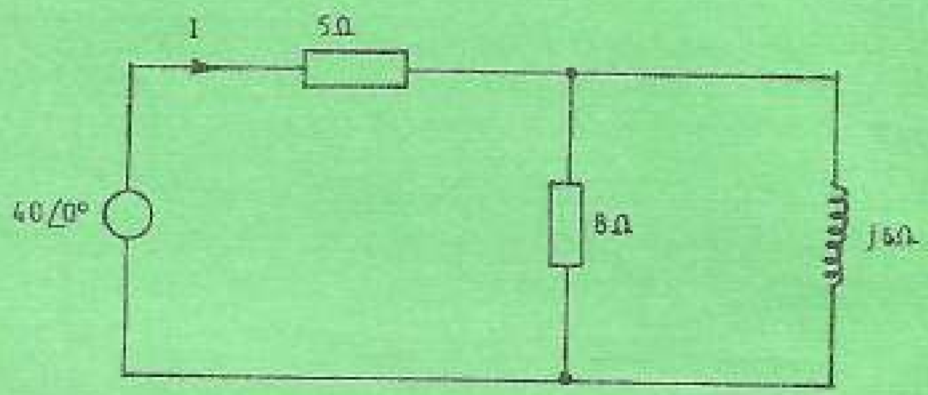

Fig. 1

(c) (i) Define the term 'time constant' with reference to transients.

(ii) A circuit consists of a resistor connect in series with a 0.4 μF capacitor and has a time constant of 12 ms. Determine the:

(I) value of resistance;

(II) capacitor voltage 7 ms after connecting the supply of 10 V.

(7 marks)

(d) With aid of diagrams, differentiate between low pass filter and high pass filter with reference to T-filter sections. (4 marks)

3. (a) Distinguish between a cage rotor and a wound rotor with reference to three phase induction motors. (4 marks)

(b) Draw the torque-speed characteristic of a three phase induction motor. (4 marks)

(c) A three phase induction motor is supplied from a 50 Hz supply and runs at a speed of 1500 rev/min when the slip is 4%. Determine the synchronous speed. (7 marks)

(d) A complex voltage waveform is given by

$V = 200 \sin \omega t + 60 \sin\left(3\omega t + \frac{\pi}{3}\right) + 20 \sin\left(5\omega t - \frac{\pi}{6}\right)$ volts and is applied across pure:

(i) 50 Ω resistance;

(ii) 20 μF capacitor.

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Determine for each case an expression for the current flowing if the fundamental frequency is 1000 Hz. (5 marks)

4. (a) (i) Name **three** types of stepper motors.

(ii) With the aid of a labelled diagram, explain the operation of a shaded pole motor. (10 marks)

(b) Draw the following circuit diagrams of D.C machines:

(i) separately excited generator;

(ii) shunt motor.

(6 marks)

(c) A 240 V d.c shunt motor draws a current of 60 A from the supply. The iron friction and windage losses are 1500 watts. The field resistance is 40 Ω and armature resistance is 0.2 Ω. Determine the overall efficiency of the motor. (4 marks)

5. (a) (i) Differentiate between a three phase synchronous motor and a three phase induction motor.

(ii) Explain the term 'voltage regulation' as used in A.C generators.

(6 marks)

(b) With the aid of a labelled diagram, describe the short circuit test of a synchronous generator. (7 marks)

(c) With the aid of a labelled diagram, describe the operation of a capacitor start capacitor run motor. (7 marks)

SECTION B: ENGINEERING DRAWING

Answer any TWO questions from this section.

6. (a) Inscribe a circle in a triangle ABC given AB = 80 mm, BC = 60 mm and AC = 96 mm. (5 marks)

(b) Construct an internal tangent to two unequal circles of diameters 66 mm and 30 mm with their centres 85 mm apart. (5 marks)

(c) **Figure 2** shows a crank mechanism. Link AB is pinjointed at end A, and end B is constrained to slide along the path XY.
Draw the locus of the midpoint M for one revolution of the crank. (10 marks)

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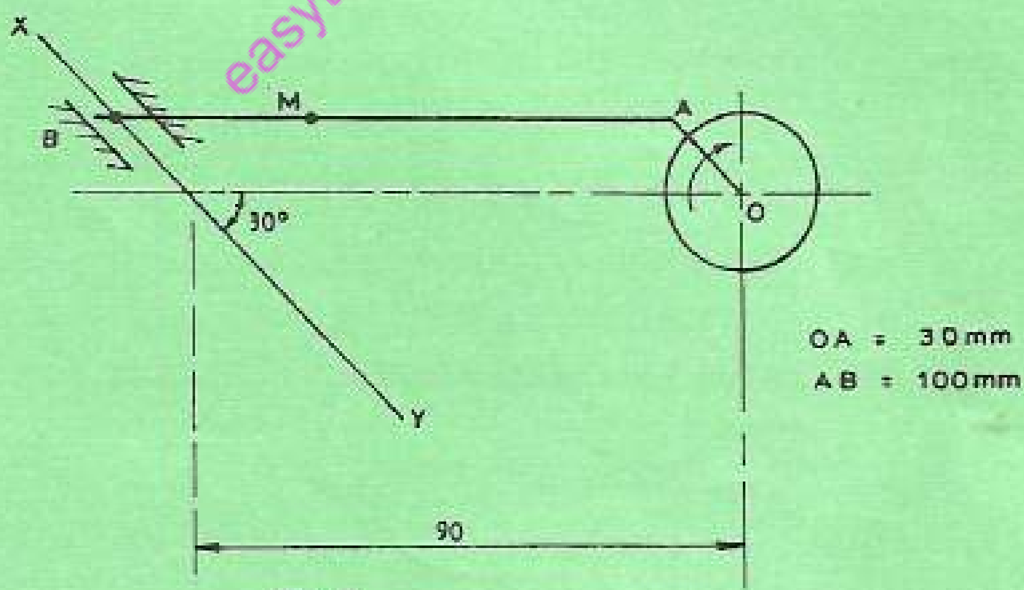

Fig. 2

7. (a) Draw the power circuit diagram of a star-delta starter of a three phase induction motor. (10 marks)

(b) Draw the BS 3939 symbols for each of the following:

(i) speaker;
(ii) zener diode;
(iii) microphone;
(iv) ammeter;
(v) intermediate switch;
(vi) heater;
(vii) energy meter;
(viii) cooker;
(ix) fluorescent;
(x) PNP transistor.

(10 marks)

8. (a) **Figure 3** shows an electronic circuit. Using any computer drawing software program:

(i) Draw the circuit;
(ii) Print and hand over the hardcopy.

(10 marks)

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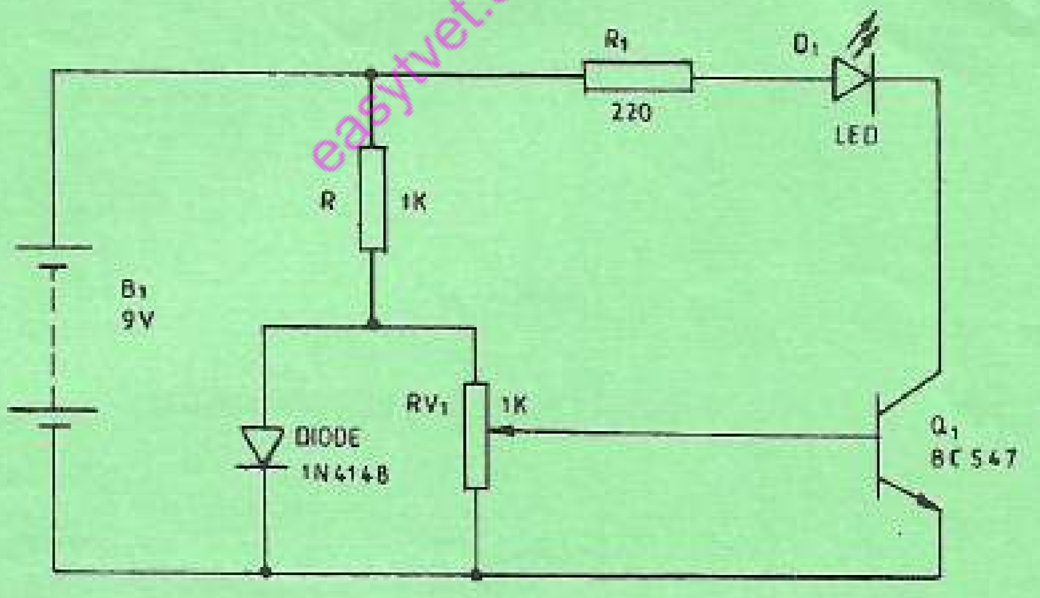
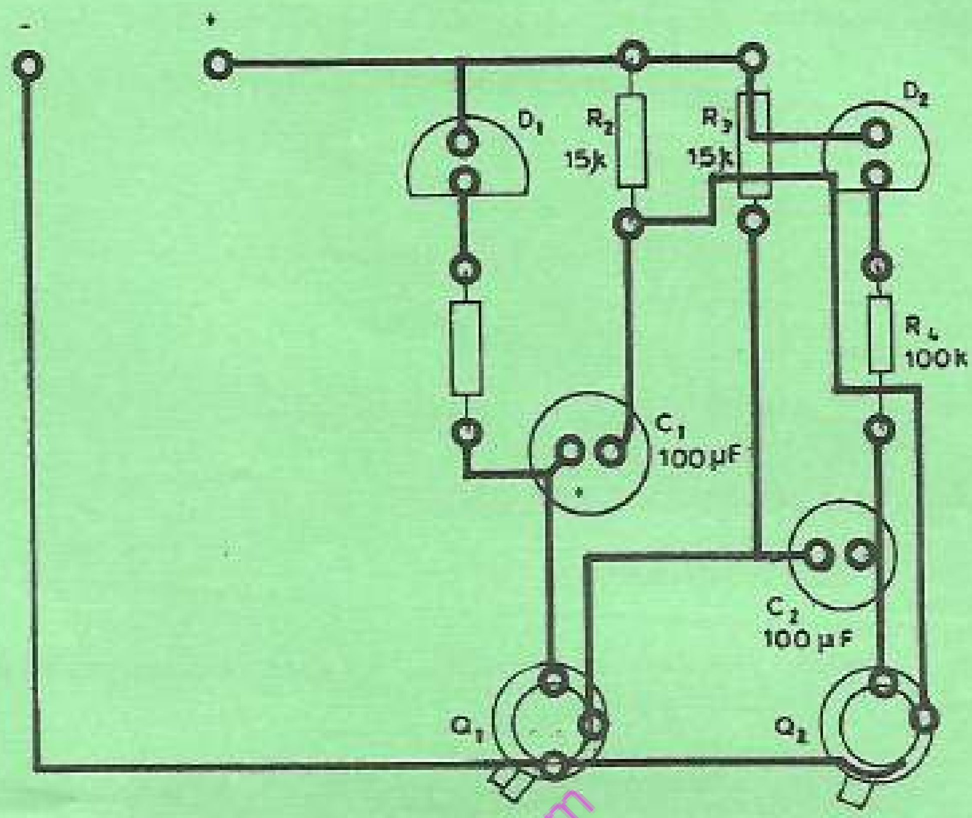


Fig. 3

(b) **Figure 4** shows a Printed Circuit Board (PCB) layout of an electronic circuit. Draw the schematic diagram of the layout. (10 marks)



D_1, D_2 LEDS
Q_1, Q_2 are PNP transistors

Fig. 4

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