

2521/204 2602/204
2601/204 2603/204
**ENGINEERING DRAWING AND
CIRCUIT ANALYSIS**
Oct./Nov. 2021
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, electronic CAD software and printer.

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

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

All questions carry equal marks.

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

All drawing dimensions are in mm.

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 any **THREE** questions from this section.

1. (a) (i) Define 'slip' as used in three phase induction motors.
(ii) Derive the Torque equation of a three phase induction motor. (8 marks)
- (b) Draw a labelled schematic diagram of a three phase 4-wire system to supply:
(i) three phase 415 V industrial load;
(ii) single phase 240 V domestic load. (4 marks)
- (c) A star connected load consists of three identical coils each of $30\ \Omega$ and inductance $127.3\ \text{mH}$. The line current is $4.8\ \text{A}$ and supply frequency $50\ \text{Hz}$. Determine the:
(i) impedance per phase;
(ii) phase and line voltages. (5 marks)
- (d) Draw a labelled schematic circuit diagram of a universal motor. (3 marks)
2. (a) (i) State 'Thevenins Theorem'.
(ii) **Figure 1** shows a D.C circuit. Using Thevenin's theorem, determine the current flowing in the $8\ \Omega$ resistor. (10 marks)

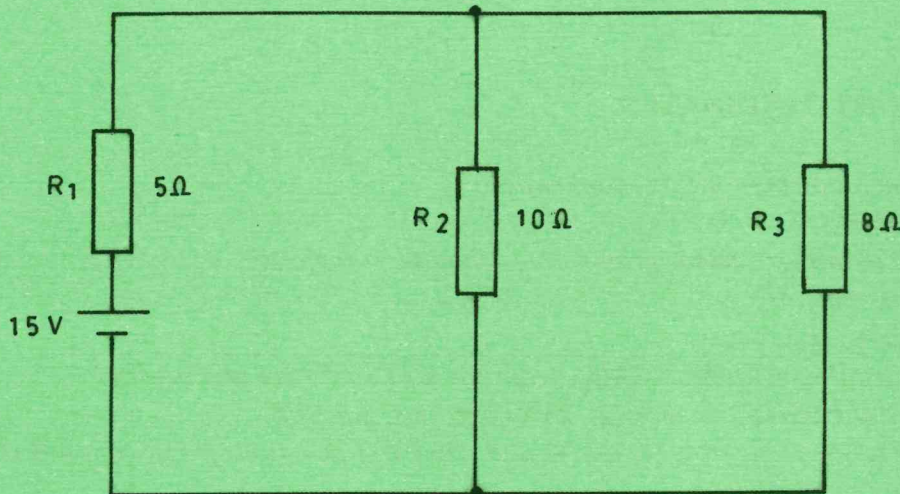


Fig.1

- (b) A current is given by the expression $2 + j3\ \text{A}$. Determine the equivalent current in:
(i) exponential form;
(ii) polar form. (4 marks)

- (c) (i) Describe 'two-port networks' citing **one** example.
(ii) With the aid of labelled schematic diagrams, distinguish between a balanced T-network and a balanced π -network. (6 marks)
3. (a) Explain the term 'transients' as used in D.C circuits. (2 marks)
- (b) (i) Draw a curve of voltage against time during discharging of a capacitor.
(ii) A $0.4 \mu\text{F}$ is charged to 240V before being connected to a $5 \text{ k}\Omega$ resistor. Determine the:
- I. initial value of discharge current;
II. time constant of the circuit;
III. time for capacitor voltage to fall to 24 V. (9 marks)
- (c) (i) Sketch a complex voltage wave form for one cycle.
(ii) A complex voltage waveform with r.m.s value of 230 V contains 30% third harmonics and 10% fifth harmonics. Both harmonics are in phase with each other. Determine the r.m.s value of the fundamentals of each harmonic. (9 marks)
4. (a) (i) Outline three methods of controlling the speed of a d.c machine.
(ii) A 480 V d.c shunt motor runs at its normal speed of 20 rev/s. when its armature current is 120 A. If the armature resistance is 0.4Ω . Determine the speed when the current is 60 A and resistance of 0.5Ω is connected in series with the armature, the shunt field remaining constant. (8 marks)
- (b) (i) Explain 'commutation' with reference to d.c machines.
(ii) Outline **three** methods of improving commutation in (b)(i). (5 marks)
- (c) (i) State **three** conditions for synchronizing an a.c machine to an existing supply.
(ii) Draw a labelled schematic diagram of synchronizing an a.c machine to an existing supply using a synchroscope. (7 marks)
5. (a) State **three** advantages of using one three phase transformers over three single phase bank of transformers of equivalent rating for the same purpose. (3 marks)

(b) Figure 2 shows a 3-phase transformer connected to a 0.75 P.F lagging balanced load.

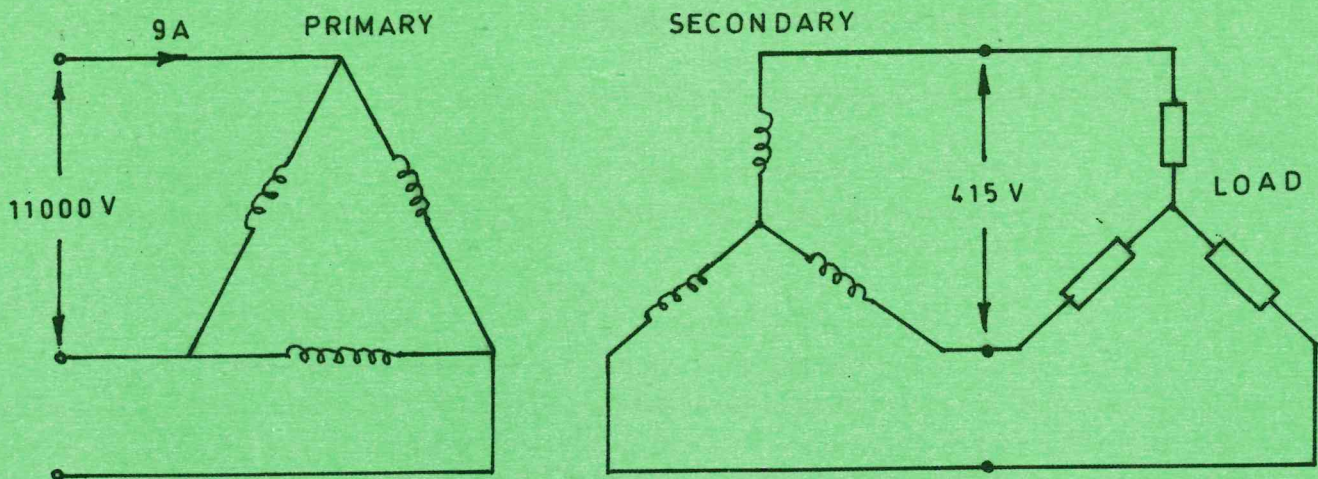


Fig. 2

Determine for both primary and secondary side the:

- (i) phase voltages;
 - (ii) phase currents;
 - (iii) output power of the transformer in kilowatt. (10 marks)
- (c)
- (i) Draw a labelled schematic diagram of a capacitor start capacitor run single phase a.c motor: (7 marks)
 - (ii) State **three** merits of the motor in (c)(i).

SECTION B: ENGINEERING DRAWING

Answer any TWO questions from this section.

6. (a) Figure 3 shows an electronic circuit.

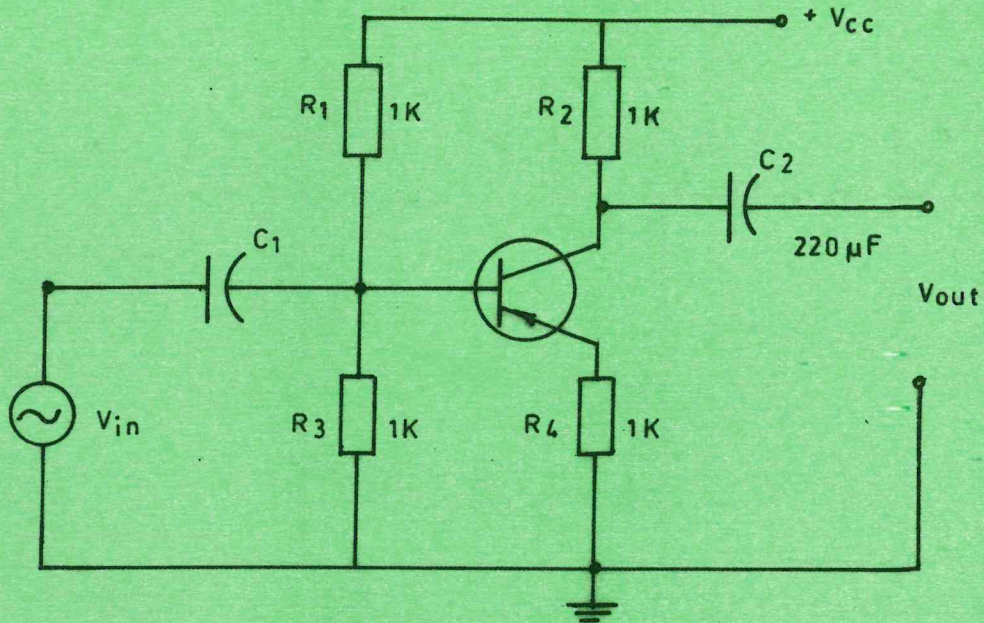


Fig. 3

Using an appropriate computer software:

- (a) Create the circuit; (10 marks)
- (b) Generate the printed circuit board (PCB). (10 marks)

Insert your index number, print the circuit and the generated PCB and hand over your work.

7. (a) Draw the power and control circuit diagrams for a direct-on line three phase induction motor starter. (10 marks)

(b) Figure 4 shows the components layout of an electronics circuit.

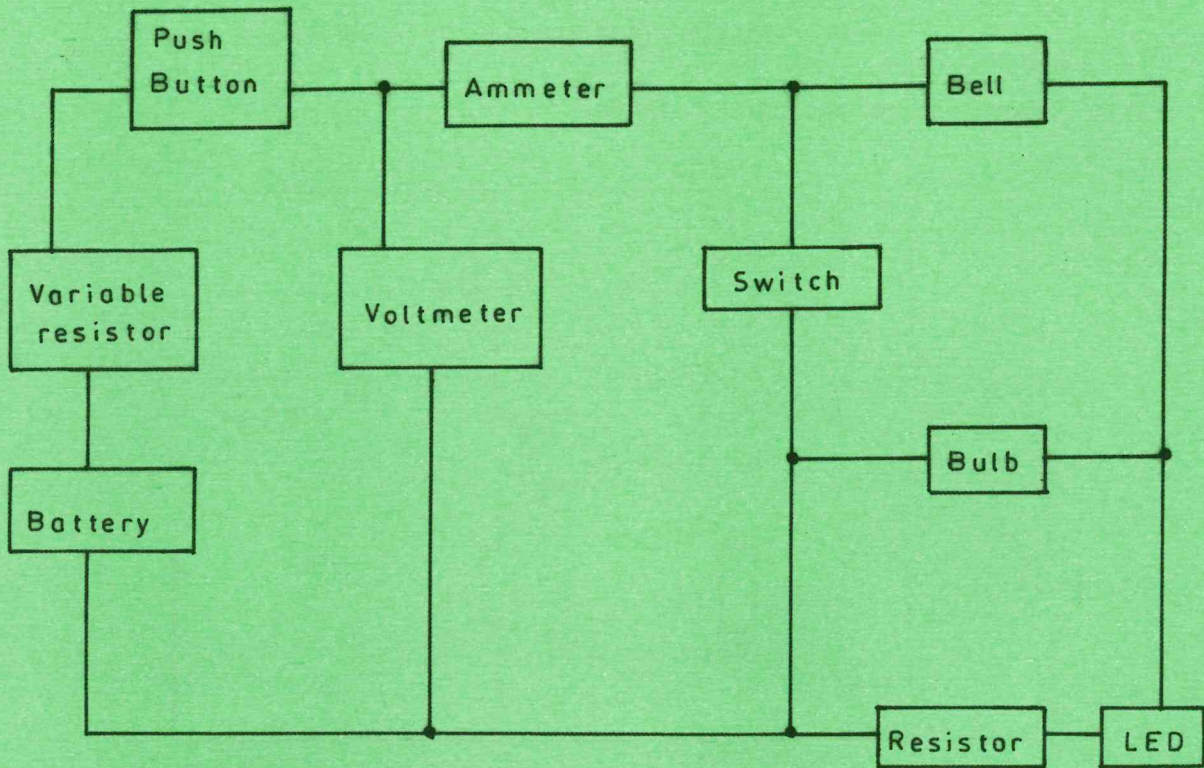


Fig. 4

Draw the circuit using the appropriate symbols.

(10 marks)

8. (a) Figure 5 shows the outline of a pulley system connected by a belt. Draw the figure showing the construction necessary to obtain the tangents between the belts and the pulleys. (10 marks)

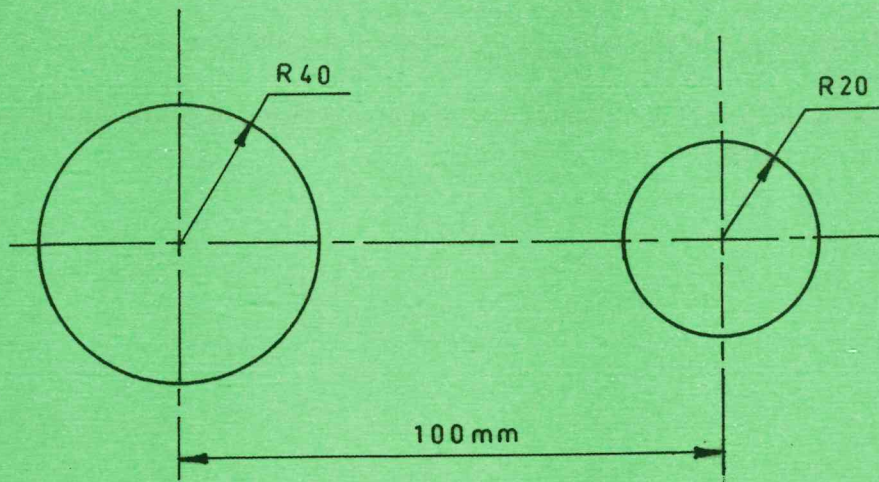


Fig. 5

- (b) **Figure 6** shows a block diagram drawn in isometric projection. Draw the figure in oblique projection with the side shown by arrow X in then horizontal plane.

(10 marks)

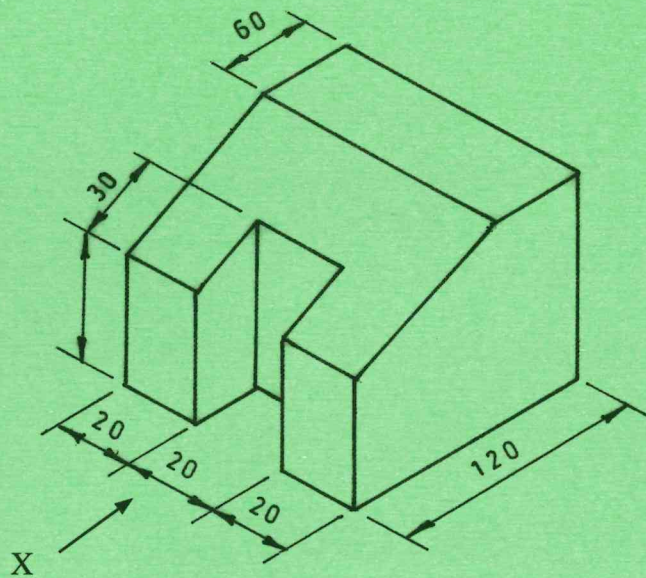


Fig.6

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