

2521/204 2602/204

2601/204 2603/204

**ENGINEERING DRAWING AND
ELECTRICAL CIRCUIT ANALYSIS**

June/June 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 ELECTRICAL CIRCUIT ANALYSIS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Drawing instruments;

Drawing papers;

Non-programmable scientific calculator;

Computer with AutoCAD program and printer.

This paper consists 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 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: ELECTRICAL CIRCUIT ANALYSIS

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

- 1/ (a) State **three** characteristics of a synchronous motor. (3 marks)
- (b) With aid of a labelled diagram, describe the construction of a cylindrical rotor of a synchronous machine. (5 marks)
- (c) State **two** merits and **two** demerits of a squirrel cage three phase induction motor (4 marks)
- (d) The frequency of the supply to the starter of 6-pole induction motor is 50 Hz and the rotor frequency is 5Hz. Determine the:
- (i) slip; $\frac{50}{60}$
- (ii) synchronous speed;
- (iii) rotor speed. (8 marks)
- 2/ (a) Distinguish between metadyne and amplidyne machine. (4 marks)
- (b) State:
- (i) One feature of a stepper motor;
- (ii) **Three** areas of application of a stepper motor. (6 marks)
- (c) (i) Differentiate between the generator and motor terminal voltage equations for DC machines;
- (ii) Name **four** constructional parts of a D.C machine. (6 marks)
- (d) A 4 pole d.c generator has a lap-wound armature with 50 slots having 18 conductors per slot. The useful flux per pole is 40 mwb. Determine the speed which the machine must be driven to generate an e.m.f of 240V. (4 marks)
3. (a) Differentiate between active and passive two-port networks. (2 marks)

$$s = \frac{n_s - n_r}{n_s} \times 100$$
$$s = \frac{1500 - 1450}{1500} \times 100$$

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- (b) Figure 1 shows a symmetrical T-network. Derive the expression of the characteristics impedance. (7 marks)

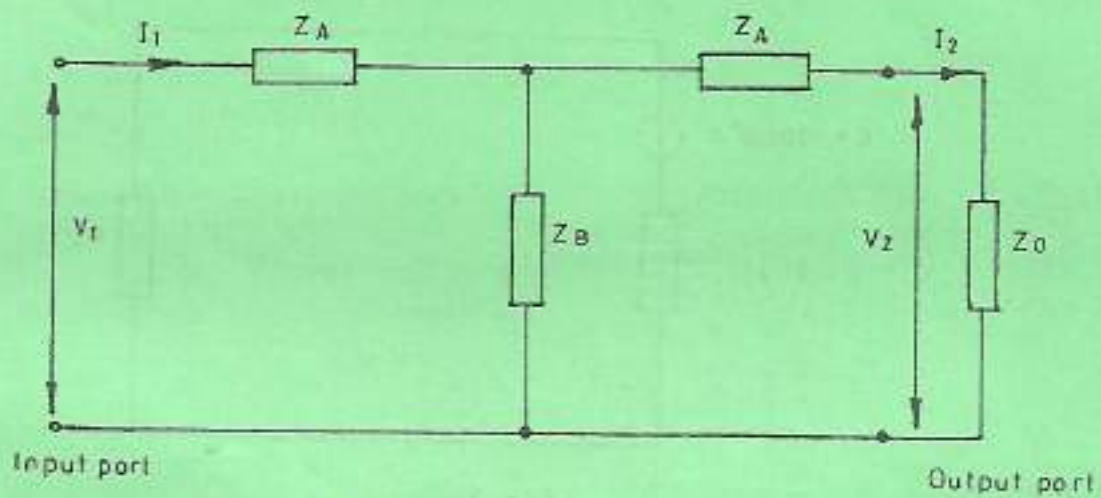


Fig.1

- (c) Name three sources of harmonics in electric circuits. (3 marks)

- (d) A complex voltage is represented by
 $V = (5 \sin \omega t + 6 \sin 3 \omega t + 2 \sin 5 \omega t)$ volts

Determine for the voltage:

- (i) Rms value;
(ii) Mean value. (8 marks)

4. (a) State the maximum power transfer theorem. (2 marks)

- (b) Figure 2 shows an electric circuit. Determine the value of load resistor R_L that gives maximum power dissipation and the value of this power. (8 marks)

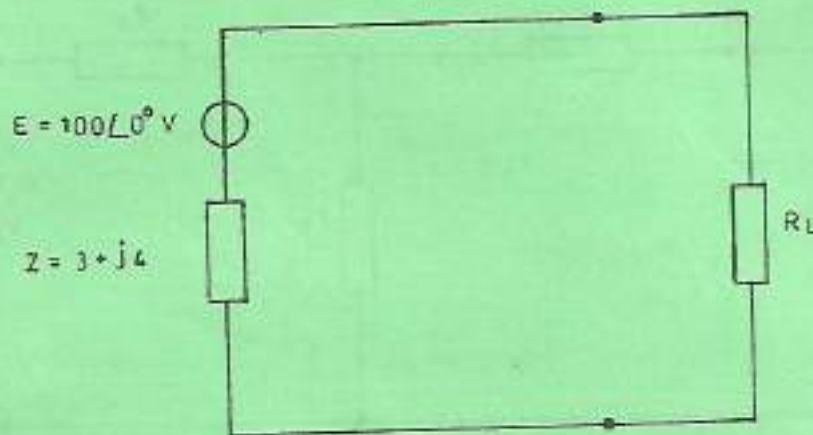


Fig. 2

- (c) A coil of inductance 0.045H and resistance of $15\ \Omega$ is connected across a 150 V d.c. supply. Determine the:
- steady state value of current flowing in the circuit;
 - Time constant of the circuit;
 - Value of induced e.m.f. after 0.3 seconds;
 - Value of current after 0.3 seconds. (8 marks)
- (d) Sketch the curve for growth of current in an R-L, d.c., circuit. (2 marks)
3. (a) (i) Explain how a single phase induction motor is made self starting.
(ii) Draw a labelled schematic diagram of a split single phase induction motor. (6 marks)
- (b) Draw a circuit diagram of a star-star three phase transformer. (4 marks)
- (c) With aid of labelled diagram, explain how three phase supply is generated. (5 marks)
- (d) A 415V , 3 Phase 4-wire System supplies three star connected resistive loads of 12 kW , 18 kW and 48 kW respectively. (4)
- Determine the:
- Phase voltage;
 - Current in each line. (5 marks)

SECTION B: ENGINEERING DRAWING

Answer any TWO questions from this section.

6. (a) Construct a Hyperbola given that the distance of the focus from the directrix is 30 mm and eccentricity is $\frac{3}{2}$. (6 marks)
- (b) Construct of regular octagon given the diameter of a circle as 100 mm. (6 marks)
- (c) Figure 3 shows a block drawn in oblique projection. Draw the figure in isometric projection. (8 marks)

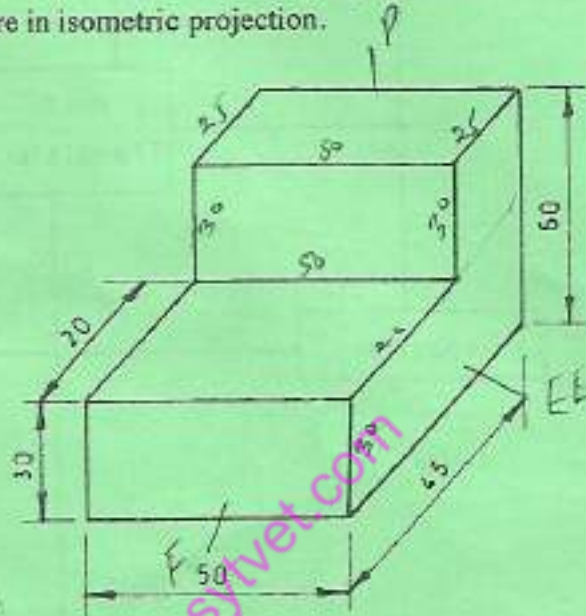


Fig 3

- 7/ (a) Figure 4 shows a layout of an electronic circuit. Draw the circuit using the appropriate symbols. (10 marks)

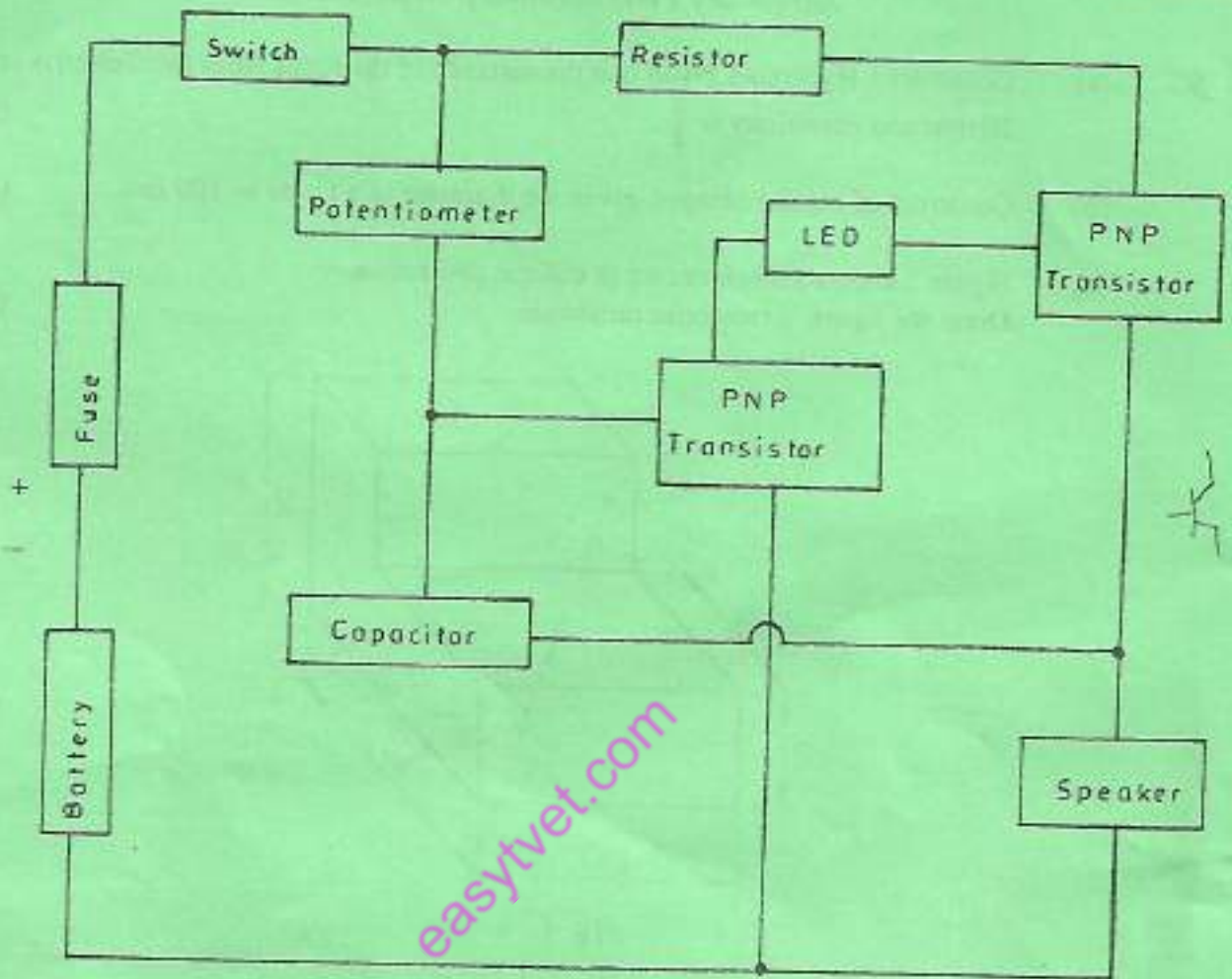


Fig. 4

- (b) Draw the power circuit for a forward-reverse three phase induction motor starter. (10 marks)

8. Figure 5 shows an electronics circuit.

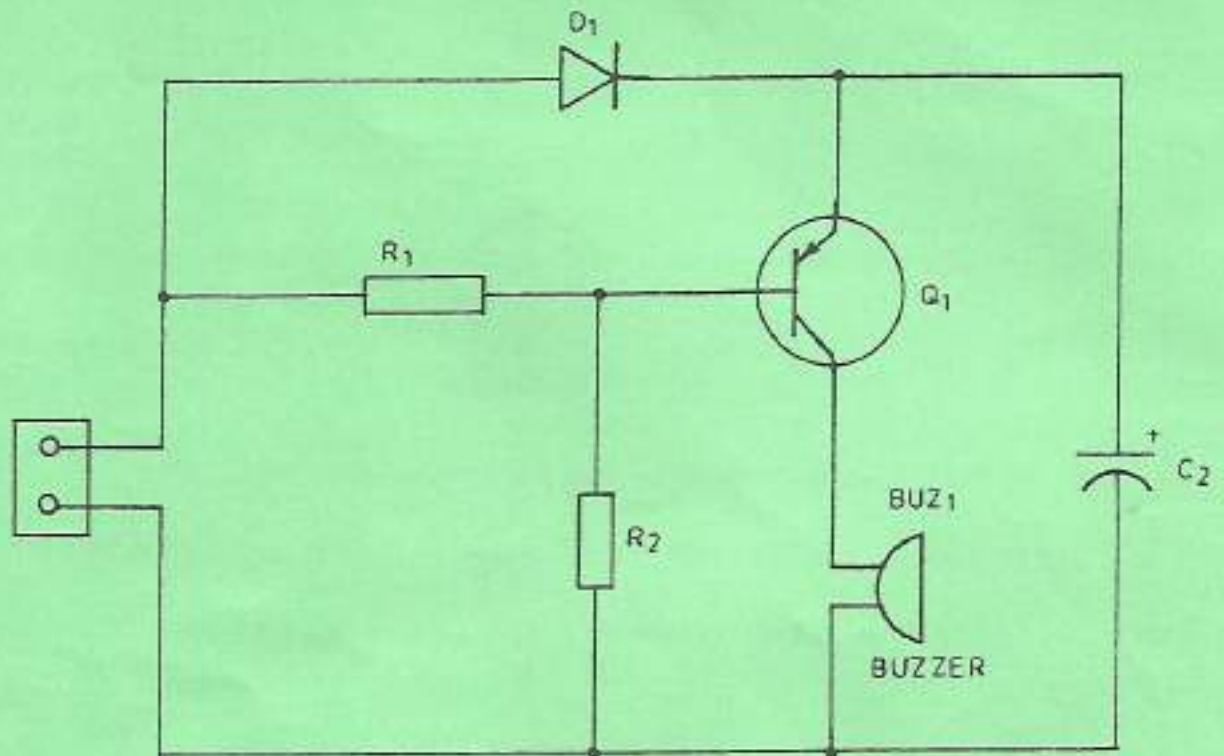


Fig.5

Using an appropriate computer software

- (a) Create the circuit. (10 marks)
- (b) Generate a printed circuit board (PCB). (10 marks)
- Insert your index number and print and hand over the hard copies of (a) and (b).

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