1521/103
1522/103
ELECTRICAL PRINCIPLES AND
ELECTRONICS TECHNOLOGY
Oct./Nov. 2011
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONICS TECHNOLOGY
POWER OPTION
TELECOMMUNICATION OPTION

MODULE I

ELECTRICAL PRINCIPLES AND ELECTRONICS TECHNOLOGY

3 hours

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INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;
Drawing instruments;
Scientific calculator/mathematical tables.

*This paper consists of **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.

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

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

1. (a) State **three** effects of electric current. (3 marks)

(b) The resistance of a copper conductor at 0°C is 15Ω. If the temperature coefficient of resistance of copepr at 0°C is 0.0042641°C, determine its resistance at 80°C.

(2 marks)

(c) (i) State Kirchhoff's current law.

(ii) **Figure 1** shows a bridge network. Use Kirchhoff's laws to determine:

I. Current in each branch.
II. p.d. across the 80Ω resistor.
III. Energy absorbed by the 100Ω resistor in 1¾ hours. (15 marks)

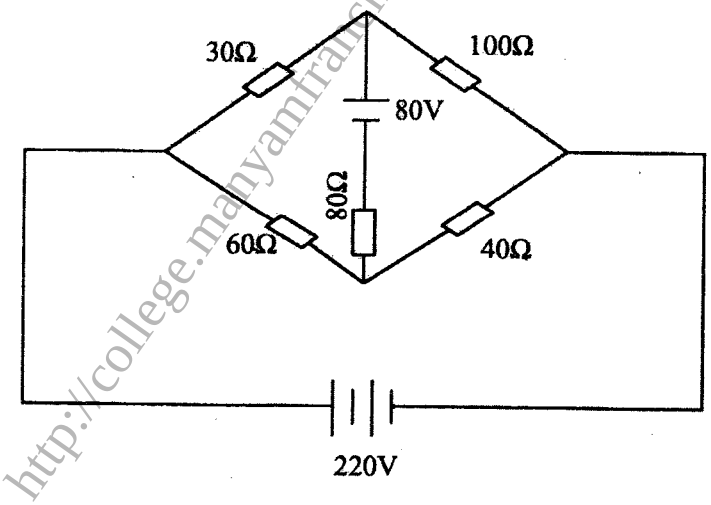

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Figure 1

2. (a) State:

(i) Faraday's laws of electrolysis.
(ii) **Two** indications of a fully charged lead acid cell.
(iii) **Three** maintenance requirements of a lead acid battery. (7 marks)

(b) With the aid of diagrams, explain the chemical reaction which takes place in a lead acid cell during charging and discharging. (8 marks)

(c) Explain the following charging methods:
(i) Trickle charge;
(ii) Floating charge. (3 marks)

(d) A car battery of twelve cells is to be charged at 10A form a 50V d.c. supply. If the terminal voltage per cell is 1.8V, determine the resistance required to give this charging current. (2 marks)

3. (a) Define the following terms with reference to electric circuits:

(i) Permittivity;

(ii) Electric flux density;

(4 marks)

(b) A parallel plate capacitor has four dielectrics of 1.5mm, 2.8mm, 3.2mm and 3.6mm thick respectively. The capacitor has a plate area of $2.5m^2$ and the relative permittivities of the four dielectrics are 2,3,5 and 8 respectively. If the capacitor is connected across a 6kV voltage supply, determine:

(i) Capacitance of the capacitor;
(ii) Charge stored by the capacitor;
(iii) Energy stored by the capacitor;
(iv) Electric flux density in the capacitor;
(v) Field strengths of the dielectrics. (11 marks)

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(c) (i) State Faraday's laws of electromagnetic induction.

(ii) Two identical coils have a resultant inductance of 27H when connected in series aiding and 15H when connected in series opposing.
If the coupling co-efficient between them is 0.52, determine.:

I. Mutual inductance between the coils.
II. Self inductance of each coil. (5 marks)

4. (a) With the aid of diagrams, explain why the magnetic flux of a transformer is almost constant form no-load to full load. (6 marks)

(b) With the aid of a waveform, derive the emf equation of a transformer. (3 marks)

(c) With the aid of diagrams, explain the following transformer tests:
(i) open circuit.
(ii) short circuit.
(6 marks)

(d) The following results were obtained on a 50KVA transformer:
Open circuit test: Primary voltage = 3300V, secondary voltage = 415V,
Primary power = 430W.
Short circuit test: Primary voltage = 124V, Primary current = 15.34A,
Primary power = 525W, Secondary current = Full load value.

Determine:
(i) Efficiency of the transformer at full load for 0.7 power factor lagging.
(ii) Efficiency of the transformer at half full load for the same power.
(iii) Voltage regulation for 0.7p.f. lagging and the secondary terminal voltage.
(iv) Voltage regulation for 0.7p.f. leading and the secondary terminal voltage.
(5 marks)

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SECTION B

*Answer any **TWO** question from this section.*

5. (a) Distinguish between intrinsic and extrinsic semiconductors.

(4 marks)

(b) With the aid of a characteristic diagram, explain the operation of a Zener diode.

(7 marks)

(c) With the aid of circuit and waveform diagrams, explain the inductor-capacitor filter.

(9 marks)

6. (a) State **three** characteristics of a common base amplifier. (3 marks)

(b) With aid of a labelled diagram, explain the operation of a class B push-pull amplifier.

(11 marks)

(c) With the aid of a labelled circuit diagram, explain the operation of a current series feedback amplifier.

(6 marks)

7. (a) Evaluate the following:

(i) 25_{10} to binary.

(ii) $110011_2 + 101101_2$

(iii) 1111 x 111

(iv) 206.104_8 to Decimal

(v) 101011_2 to Octal

(vi) $23A_{16}$ to binary

(12 marks)

(b) (i) Prove that $A + \overline{A}B = A + B$

(ii) Use De Morgan's theorem to simplify $A\overline{(B + \overline{C})}\,D$

(4 marks)

(c) An electrical signal is expressed as 101011. If the signal is applied to a NOT gate, determine graphically the output signal.

(4 marks)

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8. (a) **Figure 2** shows a D flip-flop with the input and clock waveforms applied at their respective inputs. Determine the Q waveform. (4 marks)

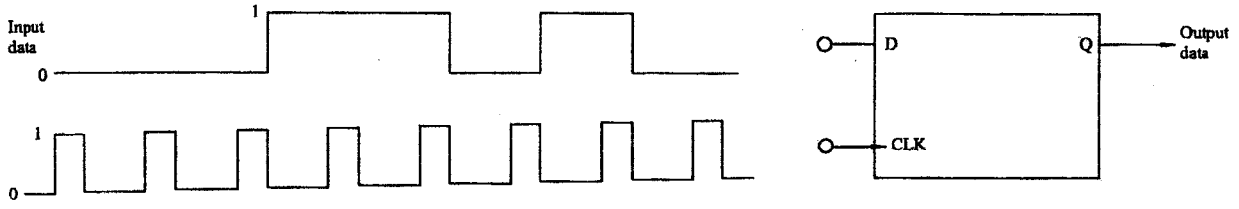

Figure 2

(b) Describe the following types of filters:

(i) Low-pass;

(ii) Bandpass;

(iii) High-pass. (6 marks)

(c) (i) Define the term 'transducer' with reference to control systems.

(ii) Describe the following types of photo electric transducers:

I. Photo emissive cell.

II. Photo conductive cell. (10 marks)

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