Province of the
EASTERN CAPE
EDUCATION

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REPUBLIC OF SOUTH AFRICA

CHIEF DIRECTORATE – CURRICULUM MANAGEMENT

GRADE 12 LEARNER SUPPORT PROGRAMME

REVISION AND REMEDIAL TEACHING INSTRUMENT: QUESTIONS AND ANSWERS

SUBJECT: ELECTRICAL TECHNOLOGY

June 2009

This document consists of 10 pages.

Strictly not for test/examination purposes

INSTRUCTIONS

1. Answer ALL the questions.
2. Sketches and diagrams must be large, neat and fully labelled.
3. All calculations must be shown and must be rounded off correctly to TWO decimal places.
4. Number the answers correctly according to the numbering system used in the question paper.
5. A formula sheet is attached at the end of the questions.
6. Non-programmable calculators may be used.
7. Mark allocation sheets must be removed from question paper and stapled to you answer book.

QUESTION 1: TECHNOLOGY, SOCIETY AND THE ENVIRONMENT

1.1 The National Curriculum Statement for Electrical Technology is sensitive to issues of diversity such as poverty. Name FIVE other similar issues. (5)

1.2 The Bill of Rights in the Constitution of South Africa states that people may not be discriminated against. Name THREE of these possible discriminations. (3)

1.3 List FOUR renewable energy resources that can replace coal-fired power stations. (4)

1.4 In the past people did a lot of writing; in offices when you wanted a birth certificate, in hospitals when patients were to be admitted, in police stations when there were cases reported and also at schools when admitting students. In the new era technology can assist a lot in recording and filing. Give ONE example of modern technology that is used to combat the problem of fraud and assist in reducing the writing load. (1)

1.5 In our society, there is a shortage of electrical power and engineers will be employed to build more power stations. When they plan to build these power stations they have to think about certain environmental factors. Explain ONE of these factors. (2)

[15]

QUESTION 2: THE TECHNOLOGICAL PROCESS

On reaching old age, some elderly people find it very difficult, and often frightening, to climb up and down stairs. Common possible solutions might be to live downstairs, to make renovations to the house, or maybe to move into an old-age home. Mrs Sebola did not want to accept any of the possible solutions. She wanted to continue to live as she has always lived. Mrs Sebola has contracted you to design the electrical device that will transport her up and down the stairs.

2.1 Mention FIVE steps to be followed when designing an artefact. (5)

2.2 What is the problem in the above scenario? (1)

2.3 Write down the design brief for the above-mentioned problem. (4)

2.4 Describe FIVE specifications of your design. (5)

[15]

QUESTION 3: OCCUPATIONAL HEALTH AND SAFETY ACT

3.1 The Occupational Health and Safety Act 85 of 1993 applies to all safety aspects of the workplace. The environmental regulations for the workplace deals with issues like thermal requirements. Name THREE more of these issues. (3)

3.2 List FIVE main routes of transmission of diseases, including the transmission of HIV/AIDS. (5)

3.3 If a person is shocked by a current of 30 to 50 milli amps, explain what the physiological effects on the body would be like. (2)

3.4 Name TWO safety aspects that should be considered when working with a ladder. (2)

3.5 Mention THREE aspects that general machinery regulations deal with. (3)

[15]

QUESTION 4: THREE-PHASE AC GENERATION

4.1 Complete FIGURE 4.1 by means of a rotational diagram, and show how the three-phase generation developments take place. The generator generates an output supply of 220 V /10 A.

(7)

FIGURE 4.1

4.2 A small alternator supplies power to a balanced inductive load. The current in each phase of the alternator is 20 A and it lags the voltage by 30^{o}. The phase voltage is 230 V if the coils of the alternator are connected in star. Calculate the following:

4.2.1 The total power that the alternator generates using the phase values. (3)

4.2.2 The total power that the alternator generates using the line values. (3)

4.3 Describe TWO advantages of a three-phase supply system when compared with a single-phase supply system. (2)

[15]

QUESTION 5: PRINCIPLE OF AC ON R, L AND C COMPONENTS

5.1 How will an increase in frequency affect:

5.1.1 The inductive reactance, and (1)
5.1.2 The capacitive reactance. (1)

5.2. Name THREE conditions that may exist for RLC- parallel resonance. (3)

5.3 A parallel RLC- network has the following components connected across a 150 V /150 Hz alternating current supply:

- Resistor = 12 Ω
- Capacitor = 70 μF
- Inductor = 15 mH

5.3.1 Draw the circuit diagram. (4)

5.3.2 Determine the following:

(a) Inductive reactance of the inductor (2)
(b) Capacitive reactance of the capacitor (2)
(c) Current flowing through each component (6)

5.3.3 Total current flowing in the network. (3)

5.3.4 Phase angle between the supply voltage and line current (also indicate whether the network is capacitive or inductive and motivate your answer); and (3)

5.3.5 Impedance of the network. (2)

5.3.6 Draw a current phasor diagram that will represent the quantities you have calculated above and insert all relevant values. (3)

5.4 A 10 Ω resistor is in series with a 300 mH inductor and a 47 μF capacitor. Calculate the resonant frequency. (4)

5.5 Mention TWO methods employed in practice to improve a poor power factor. (4)

5.6 Explain the difference between True power and Apparent power. (2)

[40]

QUESTION 6: OPERATING PRINCIPLES OF THREE-PHASE MOTORS AND CONTROL

6.1 Describe the functional operation of a three-phase induction motor. (7)

6.2 A three-phase induction motor with six poles is connected to a 380 V / 50 Hz supply. Calculate the speed of the motor if it has a full-load slip(s) of 5%. (5)

6.3 Name TWO categories of protection devices. (2)

6.4 Give THREE conditions that require monitoring and control, with reference to three-phase motors. (3)

6.5 Draw neat, fully labelled circuit diagrams for the following star/delta starting circuit:

6.5.1 Control circuit (6)
6.5.2 Main circuit (6)

6.6 The power in a three-phase induction motor that is connected to a 400 V supply is measured using the two-wattmeter method. The reading in each wattmeter is 1 200 W and 2 300 W respectively. Determine:

6.6.1 The total power that the motor draws from the supply (2)
6.6.2 The power factor at which the motor is running (4)
6.6.3 The line current of the motor (2)

6.7 All three-phase motors have internal losses. Name THREE categories of losses. (3)

[40]

QUESTION 7: OPERATIONAL AMPLIFIERS

7.1 Consider the diagram below and then answer the questions that follow.

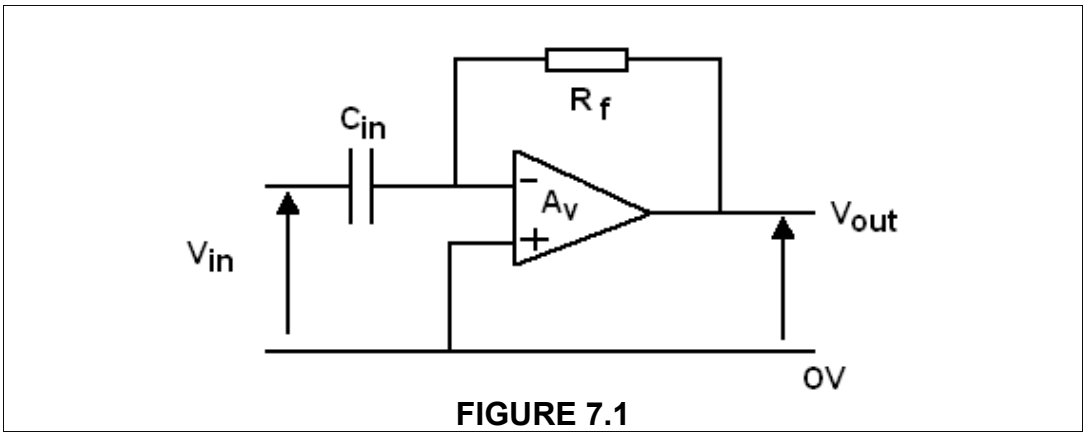

FIGURE 7.1

7.1.1 Identify the above circuit diagram. (1)
7.1.2 Draw two cycles of its input and output signal of the above circuit diagram. (6)

7.2

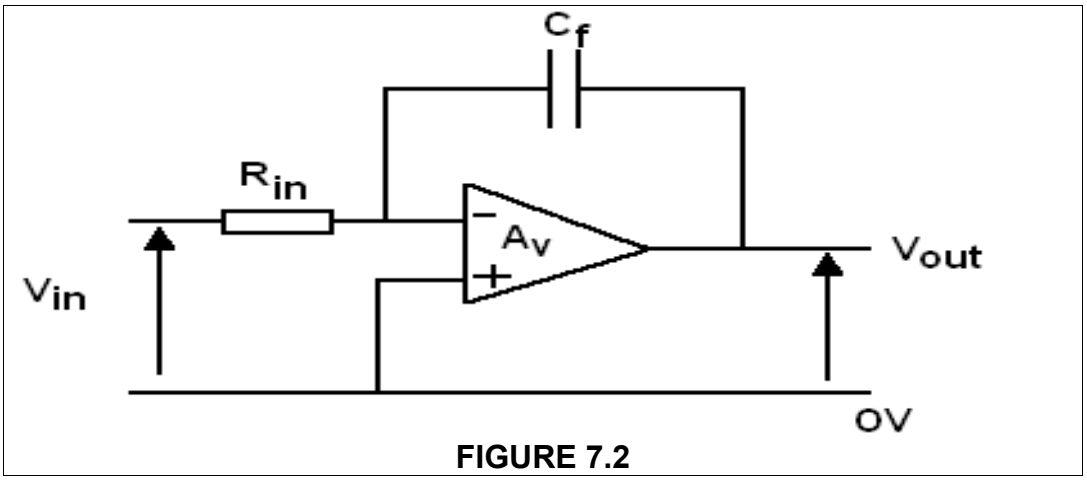

FIGURE 7.2

7.2.1 Identify the above circuit diagram. (1)

7.2.2 Give the difference between the circuit in QUESTION 7.1 and QUESTION 7.2. (2)

7.3 The Operational Amplifier can be used as summing amplifier.

7.3.1 Explain the use of this amplifier in practice. (3)
7.3.2 Draw a neat fully labelled circuit diagram of a typical three input summing amplifier. (4)
7.3.3 Draw the input and output wave diagrams of this circuit. (4)

7.4 Design a circuit which will differentiate an input signal of 300 Hz with the following information: R_f = 2 kΩ, high frequencies gain is 10.

7.4.1 Calculate the value of R_1 (3)
7.4.2 Calculate the value of C_1 (3)
7.4.3 Draw the circuit (4)

7.5 Explain the following terms:

7.5.1 Negative feedback (2)
7.5.2 Positive feedback (2)
[35]

QUESTION 8: THREE-PHASE TRANSFORMERS

8.1 Explain briefly the principle of operation of a three-phase transformer. (5)

8.2 By means of a neat fully labelled sketch show how three single-phase transformers can be connected to form a three-phase delta/star power transformer. The input is 36 kV and the output is 3,3 kV (Do not draw a schematic diagram). (5)

8.3 Discuss what is meant by Di-electric losses in transformers. (4)

8.4 Give one use for each of the following transformer connections:

8.4.1 Delta – delta (1)
8.4.2 Delta – star (1)
8.4.3 Star – star (1)

8.5 Draw a neat fully labelled diagram of a single-phase step down autotransformer. (4)

8.6 The input to a transformer is 10 kW, and the output delivered by the transformer is 8 kW. Calculate the total losses as well as the efficiency of the transformer. (4)
[25]

TOTAL: 200

FORMULA SHEET/FORMULEBLAD

$$X_L = 2\pi FL$$

$$X_C = \frac{1}{2\pi FC}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}.$$

$$I_T = \sqrt{I_R^2 + (I_C - I_L)^2}$$

$$V_T = \sqrt{I_R^2 + (V_C - V_L)^2}$$

$$F_r = \frac{1}{2\pi\sqrt{LC}}$$

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$ Parallel

$$Q = \frac{X_L}{R} = \frac{V_L}{V_R}$$ Series

$$Cos\theta = \frac{I_R}{I_T}$$

$$Cos\theta = \frac{R}{Z}$$

$$\left.\begin{aligned} P &= VI\ cos\ \theta \\ S &= VI \\ Q &= VI\ sin\ \theta \end{aligned}\right\}$$ Single phase

$$\left.\begin{aligned} P &= \sqrt{3}\,V_L I_L cos\ \theta \\ S &= \sqrt{3}\,V_L I_L \\ Q &= \sqrt{3}\,V_L I_L sin\ \theta \end{aligned}\right\}$$ Three phase

$$\left.\begin{aligned} V_L &= V_{Ph} \\ I_L &= \sqrt{3} I_{PH} \end{aligned}\right\}$$ Delta

$$\left.\begin{aligned} V_L &= \sqrt{3}\,V_{Ph} \\ I_L &= I_{Ph} \end{aligned}\right\}$$ Star

$$f = \frac{1}{T}$$

$$fc = \frac{1}{2\pi\ R1C1}$$

$$Av = \frac{R}{Rin} + 1$$

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

$$\eta = \frac{P_O}{P_I}$$

$$\beta = \frac{I_C}{I_B}$$

$$I_b = 1_e - I_c$$

$$P_G = 10\ log\ \frac{P_0}{P_i}$$

$W_1 = V_L I_L COS (B - 30^0)$
$W_2 = VL\ IL\ COS (B + 30^0)$

$$Fr = \frac{1}{2\pi\sqrt{LCeq}}$$

$$Ceq = \frac{C_1 . C_2}{C_{1+} + C_2}$$

$$\frac{\mathbf{Rf}}{\mathbf{R1}} = \boldsymbol{\alpha}$$

$$\text{Efficiency } (\hbar) = \frac{\text{output power}}{\text{input power}} \text{ x } 100\%$$

$$\mathbf{W_T = W_1 + W_2}$$

$$\textbf{POWER FACTOR} = \frac{1}{\sqrt{1+[\frac{3(p_2 - p_1)}{p_1 + p_2}]}}$$

$$fr = \frac{1}{2\pi\sqrt{LC}}$$

MARK ALLOCATION SHEET

Electrical Technology: June 2009

Learner: ..... Grade 12

	Total	Learner's Mark	Internal Moderation	District Moderation
Question 1	15			
Question 2	15			
Question 3	15			
Question 4	15			
Question 5	40			
Question 6	40			
Question 7	35			
Question 8	25			
TOTAL	200			
		Teacher	**Moderator**	**Moderator**
Signature				

NB: This sheet must be placed in the Learner's Portfolio with his answer book for moderation.