



ZIMBABWE

**MINISTRY OF HIGHER AND TERTIARY EDUCATION,
INNOVATION, SCIENCE AND TECHNOLOGY DEVELOPMENT**

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL CERTIFICATE

IN

BIOMEDICAL ENGINEERING

MODULE: Electrical And Electronic PAPER NO: 450/22/M05/2
Principles 2

DURATION: 3 Hours

JUNE 2026 EXAMINATION

REQUIREMENTS

INSTRUCTIONS TO CANDIDATE

1. Answer all questions in Section A.
2. Answer any three (3) question in Section B.
3. Do not write your name on the answer booklet.
4. Do not write anything on this question paper.

This paper consists of 5 printed pages.

QUESTION 1

- a) State Kirchoffs voltage law. (2 marks)
- b) Determine the value of the emf, E in Fig Q1b.

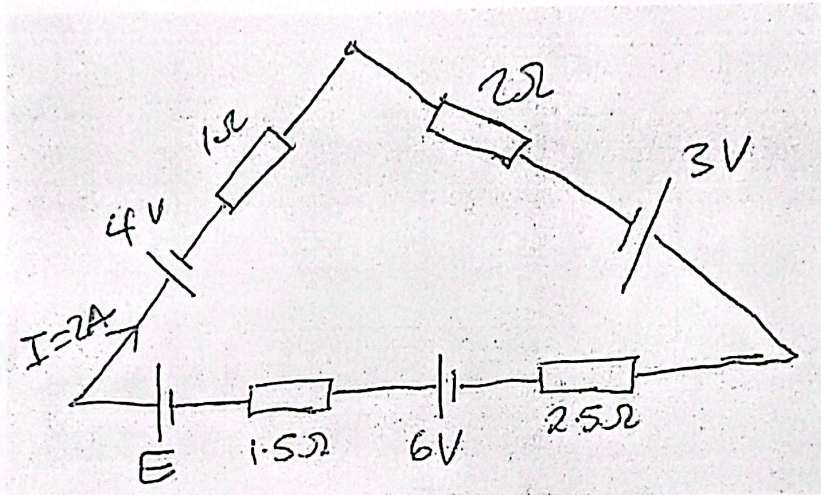


Fig Q1b

(5 marks)

- c) Consider a simple loop with a 12V battery and two resistors in series $R_1 = 4\Omega$ and $R_2 = 2\Omega$. Find the voltage drop across each resistor. (3 marks)

QUESTION 2

- a) An alternating voltage is given by $V = 75\sin(200\pi t - 0.25)V$. Find
- i) Amplitude (2 marks)
 - ii) Peak to peak value (2 marks)
 - iii) Rms value (2 marks)
 - iv) Periodic time (2 marks)
 - v) Frequency (2 marks)

QUESTION 3

- a) Differentiate between analogue and digital signals. (2 marks)
- b) Convert 25_{10} to binary. (2 marks)
- c) Define a logic gate and give the basic types. (4 marks)
- d) Define a circuit for the Boolean expression. $Y = AB + C$ (2 marks)

QUESTION 4

- a) Define the time constant of an RL circuit and explain how it is calculated. (4 marks)
- b) A 10V DC supply is suddenly applied to an RC circuit with $R = 5k\Omega$ and $C = 1\mu F$
Calculate the voltage that will appear across the capacitor after 5τ . (3 marks)
- c) Explain how an inductor behaves in a DC circuit when a switch is closed. (3 marks)

SECTION B

QUESTION 5

- a) Define a cascaded op-amp circuit. (2 marks)
- b) In a cascaded circuit with two non-inverting amplifiers, first stage has $R_f = 30K\Omega$ and $R_1 = 10K\Omega$ and the second stage has $R_f = 20K\Omega$ and $R_1 = 5K\Omega$
Calculate the overall gain. (5 marks)
- c) Find the output voltage of an inverting summing amplifier with the following specifications:
 $V = 2V, V_2 = 3V, V_3 = 4V$
 $R_1 = R_2 = R_3 = 10K\Omega$
 $R_f = 20K\Omega$ (4 marks)
- d) If the output voltage of an inverting amplifier is -15V, and the gain is -3, Calculate the input voltage. (3 marks)
- e) Explain the following laws of Boolean Algebra.
 - i) Communicative laws (3 marks)
 - ii) Associative laws (3 marks)

QUESTION 6

- Outline the steps followed when using Norton's Theorem. (5 marks)
- Use Norton's Theorem to determine the current flowing in the 10Ω resistor for the current shown in Fig Q6b.

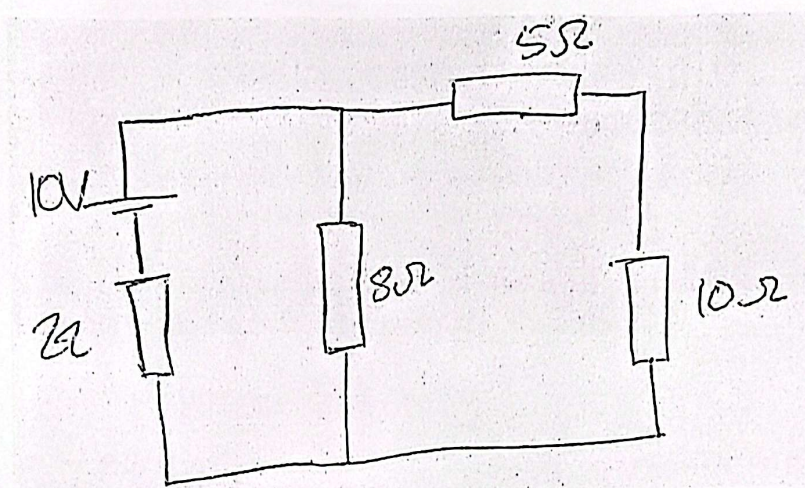


Fig Q6b

(8 marks)

- An alternating voltage, V , has a periodic time of 0.01s and a peak value of 40V . When time $t = 0$; $v = -20\text{V}$. Express the instantaneous voltage in the form.

$$V = V_m \sin(\omega t \pm \phi)$$

(7 marks)

QUESTION 7

- Design a logic circuit whose output is given by the Boolean expression $(A + B) \cdot \bar{A}\bar{B}$ (5 marks)

- Prove the following Boolean identity

$$ABC + A\bar{B}C + AB\bar{C} = A(B + C)$$

Draw the logic circuit for the simplified expression.

(8 marks)

- Simplify the following De Morgan's Theorems:

$$\overline{(M + \bar{N})((\bar{M} + N))}$$

(4 marks)

- Give the truth table and draw the symbol for the NOR gate.

(3 marks)

QUESTION 8

- a) A coil consists of a resistance of 100Ω and an inductance of 200 mH . If an alternating voltage v , given by $v = 200 \sin 500t\text{V}$ is applied across the coil, calculate:
- i) The circuit impedance (6 marks)
 - ii) The current flowing (2 marks)
 - iii) The pd across the resistance. (2 marks)
 - iv) The pd across the inductance. (2 marks)
 - v) Phase angle between voltage and current. (2 marks)
- b) A 20Ω resistor is connected in parallel with an inductor of inductance of 2.38mH across a 60V , 1kHz supply. Calculate:
- i) The current in each branch. (4 marks)
 - ii) The supply current. (2 marks)

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**HIGHER EDUCATION EXAMINATIONS COUNCIL
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NATIONAL CERTIFICATE

IN

BIOMEDICAL ENGINEERING

**MODULE: Communication and Computer
Applications**

PAPER NO: 450/22/M02

DURATION: 3 hours

JUNE 2026 EXAMINATION

REQUIREMENTS

INSTRUCTIONS TO CANDIDATE

1. Question paper has two (2) sections.
2. Section A has two (2) questions. Answer all questions in Section A.
3. Section B has four (4) questions. Answer any three (3) questions.
4. Do not write your name on any examination material, answer script and or question paper.

This paper consists of 4 printed pages.

SECTION A

Answer all questions in this section.

QUESTION 1

- a) Describe how the following word processing or spreadsheet tasks may be achieved:
- i) Underlining text (2 marks)
 - ii) Moving text (2 marks)
 - iii) Text justification (3 marks)
 - iv) Calculating the mode (3 marks)
- b) Without mentioning procedural steps, give a word or phrase that describes the following:
- i) A feature that allows you to view what a printed version of the document would look like on the screen before printing a hard copy. (2 marks)
 - ii) Replicating paragraph number 1 as paragraph numbers without retyping. (2 marks)
 - iii) A storage space that many files can be placed to group them together and organise in the computer. (2 marks)
- c) Explain the concept of mail merge in a word processor. (4 marks)

QUESTION 2

A senior engineer provides you with verbal instructions to calibrate a medical device, but the instructions are unclear due to background noise.

- a) Describe the steps you would take to clarify the instructions using the communication cycle. (10 marks)
- b) Explain how any of the 7Cs of communication can be used to ensure the instructions are accurately conveyed and understood. (10 marks)

SECTION B

QUESTION 3

- a) Explain the saving process of a power point presentation. (1 mark)
- b) Explain how to create a chart in a spreadsheet program. (6 marks)
- [Award 6 marks to any series of steps that results in the creation of a chart for example the above steps. Credit keyboard shortcut equivalent] (6 marks)
- c) Explain the purpose of the following in a database:
- | | |
|----------------|-----------|
| i) Table | (2 marks) |
| ii) Query | (2 marks) |
| iii) Report | (2 marks) |
| iv) Report | (2 marks) |
| v) Primary key | (2 marks) |
- d) State example of specific programs that belong to each of the following categories:
- | | |
|---------------------------|----------|
| i) Word processors | (1 mark) |
| ii) Spreadsheet | (1 mark) |
| iii) Presentation package | (1 mark) |
| iv) Database | (1 mark) |

QUESTION 4

- a) Discuss the importance of accessing and interpreting information from various sources. (6 marks)
- b) i) Describe three (3) different types of visual communications used in professional environments. (6 marks)
- ii) Suggest any two (2) strategies for effective implementation of visual communication. (4 marks)
- c) Differentiate between intrapersonal communication and interpersonal communication. (4 marks)

QUESTION 5

- a) You are tasked with creating a visual presentation to explain the workflow of a diagnostic laboratory to new staff members.

Design a process flow chart to visually represent the laboratory workflow.
(10 marks)

- b) Describe the formatting features that may be included in a scientific report produced using a word processor program. (10 marks)

QUESTION 6

- a) Discuss the characteristics of face-to-face communication. (8 marks)
- b) Explain any two (2) disadvantages of face-to-face communication. (4 marks)
- c) Describe any four (4) types of work-related documents used in a biomedical context. (8 marks)

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NATIONAL CERTIFICATE

**IN
BIOMEDICAL ENGINEERING**

**MODULE: Communication and Computer PAPER NO: 450/25/M02
Applications with C Programming**

DURATION: 3 Hours

JUNE 2026 EXAMINATION

REQUIREMENTS

Non-programmable scientific calculator

INSTRUCTIONS TO CANDIDATE

1. Answer all questions in Section A.
2. Answer any three (3) questions in Section B.

This paper consists of 4 printed pages.

PAPER NO:450/25/M02- COMMUNICATION AND COMPUTER APPLICATIONS

QUESTION 1

- a) Define communication. (2 marks)
- b) State and briefly explain any four (4) elements of the communication cycle. (4 marks)
- c) Identify two (2) barriers to effective communication and explain how they affect communication. (4 marks)

QUESTION 2

- a) State any four (4) characteristics of effective communication. (4 marks)
- b) Give two (2) advantages and two disadvantages of written communication. (4 marks)
- c) Outline 2 situations where verbal communication is more appropriate than written communication. (2 marks)

QUESTION 3

- a) List any four (4) uses of spreadsheets in biomedical engineering. (4 marks)
- b) State two (2) functions of word processing software in technical documentation. (2 marks)
- c) Explain how power point presentation can be useful in biomedical engineering. (4 marks)

QUESTION 4

- a) Define the following terms C programming
 - i) Variable (2 marks)
 - ii) Loop (2 marks)
- b) State two (2) examples of input device / sensors used in biomedical systems. (2 marks)
- c) Identify two (2) basic ladder logic components and state their functions. (4 marks)

SECTION B

QUESTION 5

- a) Describe the communication process using a clearly labelled diagram. (8 marks)
- b) Explain four (4) factors to consider when choosing a channel of communication. (8 marks)
- c) Outline two (2) methods of accessing and interpreting technical information in biomedical engineering. (4 marks)

QUESTION 6

- a) Detail how excel (spreadsheets) can be used to
 - i) Analyse data (3 marks)
 - ii) Perform calculations (3 marks)
 - iii) Present results (3 marks)
- b) Explain the steps involved in creating a technical report using word processor. (7 marks)
- c) State two (2) advantages of using charts/graphs in data presentation. (2 marks)

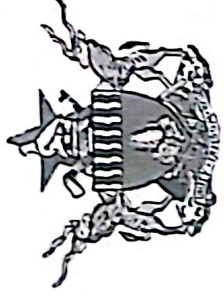
QUESTION 7

- a) Explain the following C programming concepts with examples.
 - i) Data types (4 marks)
 - ii) Conditional statements(if/else) (4 marks)
- b) Write a simple C program to
 - i) Input three (3) numbers (4 marks)
 - ii) Calculate and display the average (4 marks)
- c) State two methods used to debug programs. (4 marks)

QUESTION 8

- a) Define ladder logic and state its importance in biomedical systems. (4 marks)
- b) Draw and explain a simple start up circuit using ladder logic. (8 marks)
- c) Explain the following ladder logic components
 - i) Timer (2 marks)
 - ii) Counter (2 marks)
 - iii) Interlocking (2 marks)
- d) State two (2) applications of ladder logic in medical equipment. (2 marks)

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NATIONAL CERTIFICATE

IN

BIOMEDICAL ENGINEERING

**MODULE: Biomedical Equipment Installation PAPER NO: 450/22/M06
(Instrumentation)**

DURATION: 3 hours

JUNE 2026 EXAMINATION

REQUIREMENTS

Non-programmable scientific calculator

INSTRUCTIONS TO CANDIDATE

1. Question paper contains two (2) sections, Section A and Section B.
2. Answer all questions in Section A.
3. Each question in Section A carries ten (10) marks.
4. Section B has four (4) questions.
5. Each question in Section B carries 20 marks.
6. Choose three (3) out of four (4) questions in Section B.
7. Do not write your name in the question paper or answer script.

This paper consists of 4 printed pages.

SECTION A

Answer all questions.

QUESTION 1

- a) Define electrocardiography? (1 mark)
- b) State the various parts of a generalised instrumentation system. (6 marks)
- c) Describe the characteristics of resting potential. (3 marks)

QUESTION 2

- a) Classify biomedical instruments, giving examples for each class. (8 marks)
- b) State the two (2) types of blood pressure measurement methods. (2 marks)

QUESTION 3

- a) Name the three (3) different types of electrodes. (3 marks)
- b) Define the term transducer and state two (2) types of transducers. (4 marks)
- c) Describe the use of an infrared thermometer. (3 marks)

QUESTION 4

Define any five (5) system characteristics considered when designing a biomedical instrumentation system. (10 marks)

PAPER NO: 450/22/M06 – BIOMEDICAL EQUIPMENT INSTALLATION
(INSTRUMENTATION)

SECTION B

Choose three (3) out of four (4) questions.

QUESTION 5

- a) What is telemedicine, in your answer briefly describe its importance. (5 marks)
- b) State five (5) measurements taken on a human being for diagnosis purposes including the instruments used to measure each parameter. (10 marks)
- c) Outline instruments used for measuring parameters stated in part (b). (5 marks)
- d) Define the term calibration and briefly explain one (1) calibration method of your choice. (5 marks)

QUESTION 6

- a) State the seven (7) SI base units. (7 marks)
- b) State the following derived units of measurements in SI base units.
 - i) Density (1 mark)
 - ii) Weight (1 mark)
 - iii) Power (2 marks)
- c) Describe three (3) characteristics of a measurement system. (6 marks)
- d) State the three (3) types of medical devices. (3 marks)

QUESTION 7

- a) Briefly describe how you would protect yourself against electrical hazards identified during installation. (5 marks)
- b) Define the term leakage current. (4 marks)
- c) State six (6) hospital departments that require medical equipment installation. (6 marks)
- d) Describe safety considerations when installing an x-ray machine. (5 marks)

PAPER NO: 450/22/M06 – BIOMEDICAL EQUIPMENT INSTALLATION
(INSTRUMENTATION)

QUESTION 8

Using a labelled sketch, illustrate the setup of a surgical theatre. Your answer
(20 marks)
should include at least ten (10) biomedical equipment.

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NATIONAL CERTIFICATE

IN

BIOMEDICAL ENGINEERING

**MODULE: Engineering Mathematics PAPER NO: 450/22/M07
450/25/M07**

DURATION: 3 Hours

JUNE 2026 EXAMINATION

REQUIREMENTS

Non-programmable calculator and graph paper.

INSTRUCTIONS TO CANDIDATE

1. Answer all questions in Section A. Each question carries 10 marks.
2. Answer any three (3) questions in Section B. Each question carries 20 marks.
3. Do not write your name or surname on the question paper or answer booklet.
4. Do not write anything on the question paper.

This paper consists of 5 printed pages.

SECTION A

40 MARKS

Answer all questions.

QUESTION 1

- (a) Solve the following equations by substitution

$$x + 2y = -1$$

$$4x - 3y = 18$$

(4 marks)

- (b) Solve the following equations:

$$15x^2 + 2x - 8 = 0$$

(4 marks)

- (c) Without plotting a graph, determine the gradient and y-axis intercept values for the following equations

$$3y = -6x + 2$$

(2 marks)

QUESTION 2

- (a) Evaluate: $\log_3 \frac{1}{81}$

(3 marks)

- (b) $PV = mRT$ is the characteristic gas equation. Find the value of the gas constant R when pressure $P = 3 \times 10^6 \text{ Pa}$, volume $V = 0.90 \text{ m}^3$, mass $m = 2.81 \text{ kg}$ and temperature $T = 231 \text{ K}$.

(4 marks)

- (c) Solve $\frac{7}{4} = e^{3x}$ correct to 4 significant figures.

(3 marks)

QUESTION 3

- (a) Distinguish between vectors and scalars, and give examples of each.

(4 marks)

- (b) Convert the following angles to radians, correct to 3 decimal places

(i) 73°

(2 marks)

(ii) $25^\circ 37'$

(2 marks)

- (c) If $\tan B = \frac{8}{15}$ determine the value of $\sin B$.

(2 marks)

QUESTION 4

(a) Convert 11011_2 to a decimal number. (3 marks)

(b) Evaluate the following expression using laws of indices.

$$\frac{10^3 \times 10^2}{10^8} \quad (3 \text{ marks})$$

(c) Show that $\cos^2 \theta - \sin^2 \theta = 1 - 2\sin^2 \theta$ (4 marks)

SECTION B

QUESTION 5

(a) Differentiate from first principles the following function: $f(x) = 2x^3$ (5 marks)

(b) An alternating voltage is given by $v = 1000 \sin 200t$ volts, where t is the time in seconds. Calculate the rate of change of voltage when

(i) $t = 0.005$ s (2 marks)

(ii) $t = 0.01$ s (2 marks)

(c) Differentiate $y = \frac{te^{2t}}{2\cos t}$ (5 marks)

(d) Expand and simplify the following expressions

(i) $\sin(\pi + \alpha)$ (3 marks)

(ii) $-\cos(90^\circ + \beta)$ (3 marks)

QUESTION 6

(a) Determine: $\int \frac{3}{x^2} dx$ (4 marks)

(b) Evaluate:

$$\int_0^{\frac{\pi}{2}} 3 \sin 2x \, dx \quad (4 \text{ marks})$$

- (c) Determine the area enclosed by $y = 2x + 3$; the x axis and ordinates $x = 1$ and $x = 4$. (6 marks)
- (d) A sinusoidal voltage is given by $v = 100 \sin \omega t$ volts. Determine the mean value of the voltage over half a cycle using integration. (6 marks)

QUESTION 7

- (a) Define a complex number. (2 marks)

- (b) Give that $Z_1 = z + j4$; $Z_2 = 3 - j$ Determine the following, showing the results on an Argand diagram.

(i) $Z_1 + Z_2$ (3 marks)

(ii) $Z_1 - Z_2$ (3 marks)

(iii) $Z_2 - Z_1$ (3 marks)

- (c) Evaluate: $\frac{Z_1 Z_2}{Z_1 Z_2}$; in the form $a + jb$

Given that $Z_1 = 1 - j3$ and $Z_2 = -2 + j5$ (5 marks)

- (d) Solve the following equation

$(x - j2y) + (y - j3x) = 2 + j3$ (4 marks)

QUESTION 8

- (a) Define the following terms:-

(i) Displacement (2 marks)

(ii) Velocity (2 marks)

(iii) Acceleration (2 marks)

- (b) A bus is moving at a speed of 20 ms^{-1} begins to slow down at a constant rate of 3 ms^{-1} each second. Find how far it goes before stopping. (3 marks)

- (c) Define the following terms: -

PAPER NO: 450/22/M07 &450/25/M07 – ENGINEERING MATHEMATICS

(i) angular velocity (2 marks)

(ii) constant angular acceleration. (2 marks)

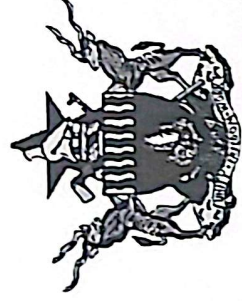
(d) An object starts from rest with a constant acceleration of 8ms^{-2} along a straight line. Find: -

(i) The speed after 5s. (2 marks)

(ii) The average speed for the 5s interval (2 marks)

(iii) The distance travelled after the 5s. (3 marks)

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NATIONAL CERTIFICATE

IN

BIOMEDICAL

**MODULE: Safety, Health and Environmental PAPER NO: 450/25/M01
Quality**

DURATION: 3 Hours

JUNE 2026 EXAMINATION

REQUIREMENTS

Non-programmable scientific calculator

INSTRUCTIONS TO CANDIDATE

1. Section A-Answer all questions.
2. Section B- Answer any three (3) questions.

This paper consists of 3 printed pages.