



University of Ruhuna - Faculty of Technology
Bachelor of Engineering Technology Honours Degree
Level 4 (Semester I) Examination, June 2023
Academic year 2021/2022

Course Unit: ENT4152 Biomedical Equipment (Written)

Duration: 3 hours

Index No: TG/_____/_____

- This question paper carries **five (5)** questions in **eight (8)** pages excluding the cover page.
- Answer **ALL** questions.
- You may use calculators if needed.
- All symbols have their usual standard.
- Multiple choice questions have **only ONE** correct answer, out of the options given. **Circle** only the correct answer **in the question paper itself**.
- Please put your index number of every page of the question paper.
- Please attach **ALL** pages of this question paper to your answer script.
- Each question carries 12 marks totaling to 60% of your final grade.

Question	Sub Questions	LO	Total	1 st Examiner	2 nd Examiner
Q1	24 Sub Questions	LO1	12		
Q2	4 Sub Questions	LO2	12		
Q3	12 Sub Questions	LO2	12		
Q4	5 Sub Questions	LO4	12		
Q5	4 Sub Questions	LO3	12		
			60		

Question 1

Circle one (1) of the options that best suits each question.

(0.5 each × 24 = 12 marks)

1. Which of the listed terms is described by: “All the chemical processes that take place in the organelles and cytoplasm the cells of the body”?
(A) Metabolism
(B) Cellular respiration
(C) Homeostasis
(D) Physiology
2. Which plane of the body divides it into dorsal and ventral regions?
(A) Transverse
(B) Axial
(C) Coronal
(D) Sagittal
3. Which of the following is the best definition of physiology?
(A) The microscopic study of tissues and cells
(B) The study of how the body works.
(C) All the chemical processes that take place in the organelles of the body’s cells.
(D) The body’s automatic tendency to maintain a relatively constant internal environment.
4. Which of the following statement is TRUE?
(A) Appendicular part of the human body consists of the upper and lower extremities.
(B) Human bodies are divided into three main regions, head, thorax and abdomen.
(C) The dorsal body cavity contains the thoracic and abdominopelvic cavities.
(D) The “appendix” is coming under left lower quadrant.
5. Which one of the following statements is correct?
(A) The diaphragm separates the brain and spinal cord
(B) The ventral cavity contains the male and female reproductive system
(C) The abdomino-pelvic cavity contains the spinal cord.
(D) The dorsal cavity contains the brain and spinal cord
6. Complete the sentence correctly: “Cervical vertebrae are.....
(A) superior to the rib cage.
(B) inferior to the thoracic vertebrae.
(C) located between the thoracic and sacral vertebrae.
(D) fused into a single bone called the sacrum.
7. Which of the following statement is FALSE regarding human body systems?
(A) The integumentary system provides protection for the body.
(B) The lymphatic system returns excess fluid and protein to the blood and helps defend the body against infection and tissue damage.

- (C) The skeletal system moves the body and its internal parts, maintains posture, and produces heat.
- (D) The circulatory system serves as a distribution system for the body.
8. Choose one answer below that completes the following sentence so that it makes a true statement: "Positive feedback"
- (A) is the way the body maintains homeostasis
- (B) is a response that opposes a stimulus
- (C) is a response that maintains a dynamic state of equilibrium
- (D) is a response that enhances a stimulus
9. The human body's ability to maintain a relatively constant internal temperature is an example of what?
- (A) Respiratory heat loss
- (B) Homeostasis
- (C) Vasodilation and evaporative heat loss
- (D) Positive feedback
10. Where is the mitral valve of the heart located?
- (A) Between the left atrium and left ventricle
- (B) Between the left ventricle and the aorta
- (C) Between the right ventricle and the pulmonary trunk
- (D) Between the right atrium and right ventricle
11. Choose the structure known as the pacemaker of the heart from the following.
- (A) Atrio-ventricular node
- (B) Sino-atrial node
- (C) Atrio-ventricular bundle
- (D) The bundle of His
12. Where is the aortic valve located?
- (A) Between the right atrium and right ventricle
- (B) Between the right ventricle and the pulmonary trunk
- (C) Between the left ventricle and the aorta
- (D) Between the left atrium and left ventricle
13. Complete the sentence correctly: "The left ventricle pumps"
- (A) more blood than the right ventricle
- (B) blood at a lower pressure than the right ventricle
- (C) less blood than the right ventricle
- (D) blood at a higher pressure than the right ventricle
14. In a normal ECG trace, what does a QRS wave indicate?
- (A) Depolarisation of the atria
- (B) Repolarisation of the atria
- (C) Depolarisation of the ventricles
- (D) Repolarisation of the ventricles
15. A scuba diver swimming at a depth of 10 m will experience a pressure of how many atmospheres?

- (A) 1.0
 - (B) 2.0
 - (C) 3.0
 - (D) 1.5
16. 15. In which of the following situations would the greatest pressure be produced?
- (A) A force of 500 N acts on an area of 0.1 m².
 - (B) A force of 800 N acts on an area of 0.1 m².
 - (C) A force of 300 N acts on an area of 0.2 m².
 - (D) A force of 500 N acts on an area of 0.2 m².
17. What term is applied to the volume of air that moves into the lungs while breathing at rest?
- (A) Anatomical dead space
 - (B) Inspiratory reserve capacity
 - (C) Tidal volume
 - (D) Residual volume
18. Which structures constitute the “upper respiratory tract”?
- (A) Nose, Pharynx and Larynx
 - (B) Larynx, Epiglottis and Bronchi
 - (C) Trachea, Bronchi and Bronchioles
 - (D) Terminal bronchioles, Alveoli and Pleurae
19. What is the gap between the plasma membranes of a neuron that conducts an incoming signal and the cell that is going to receive the signal called?
- (A) Neuromuscular junction
 - (B) Intercellular cleft
 - (C) Synaptic cleft
 - (D) Intercalated disc
20. Which part of the neurone carries the “action potential”?
- (A) The cell body
 - (B) The dendrites
 - (C) The synaptic knobs
 - (D) The axon
21. What event during the action potential causes the resting membrane potential to change from about -70 mV to about +30 mV?
- (A) K⁺ ions moving into the cell
 - (B) K⁺ ions moving out of the cell
 - (C) Na⁺ ions moving into the cell
 - (D) Na⁺ ions moving out of the cell
22. Where is the autonomic control centre for most of body homeostasis located?
- (A) In the limbic system
 - (B) In the brainstem
 - (C) In the hypothalamus
 - (D) In the cerebellum

23. Which of the following statements is/are TRUE.
- i) Chest X ray has high exposure to radiation but not as high as a body CT or cardiac angiography.
 - ii) Dental X ray has a very low effective dose of exposure.
 - iii) Ultrasound is more dangerous than X ray in terms of effective radiation dose.
- (A) i and ii only
 (B) ii and iii only
 (C) i and iii only
 (D) ALL of the above are true
24. Which of the following statements is/are TRUE.
- i) X rays cannot be stopped by thin aluminum but can be stopped by water or concrete.
 - ii) Gamma rays and X rays have similar penetration.
 - iii) Alpha rays have higher ionization than X rays.
- (A) i and ii only
 (B) ii and iii only
 (C) i and iii only
 (D) ALL of the above are true

Question 2

1. Kamala who recently got married, does not have a good idea about X-rays. She needs to get a dental X-ray done for a tooth filling. However, she refuses to get the X-ray as she says the radiation can cause DNA damages. What is your recommendation to Kamala based on the knowledge of X-rays? Justify your answer.
 (3 marks)
2. You are a biomedical equipment technician at the local hospital radiology department. The hospital recently purchased a MRI machine but patients are reluctant to get the MRI scans due to harmful radiation. The radiology department has appointed you to educate the public on this matter. Write a short essay regarding what you will tell the public regarding the MRI scans and the possible effect of the machine (1 paragraph is enough).
 (3 marks)
3. Give a brief description of each of the following in regard to ultrasound.
 - a) B mode grey scale imaging
 - b) Doppler imaging
 (4 marks)
4. Write a brief safety notice to be given to a laboratory technician regarding laser safety procedures.
 (2 marks)

Question 3

Answer questions 1 to 12 in the space provided. Each question carries 1 mark.

1. Describe the main steps of maintenance procedure of a mechanical ventilator?

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2. Briefly explain the difference between disinfection and sterilization?

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3. Give two (02) examples for the things that cannot go in an autoclave but must go in an ethylene oxide sterilizer?

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4. Briefly explain the possible harms of ultrasound in medicine?

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5. Can salt water be used as a conductor in EEG devices instead of using a gel? Justify your answer.

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6. Briefly explain the difference between defibrillators available at the hospital and Automated External Defibrillators (AED) available in other places?

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7. What is the training required to operate an AED?

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8. List the main components you need, if you had to make a syringe pump.

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9. How is a 12-lead ECG different from a single-lead ECG in terms of information captured?

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10. What is the Einthoven's triangle in ECG?

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11. Briefly explain a patient's responsibility at home to take care of a pacemaker?

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12. Briefly explain how to distinguish a birthing bed from a normal hospital bed?
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Question 4

1. a) Name all the government biomedical engineering units in the Southern Province.
b) Who operates these biomedical engineering units mentioned in 1 a)? (2 marks)
2. What are the main steps in repairing existing medical equipment? Include decision making step also in your answer. (2 marks)
3. The World Health Organization (WHO) gives underlying principles of good donation practice. List two (2) of these and briefly describe them. (2 marks)
4. You are a Biomedical Equipment Technician at the Biomedical Engineering Unit in a private hospital. You are required to give a talk to newly recruited Biomedical Equipment Technicians under the topic "Careless repairs may put a patient at risk". List out and briefly describe the main points that you would use in your talk. (3 marks)
5. List one (01) of the outputs of a Battery Management System (BMS) and briefly describe why it is important for a BMS. (3 marks)

Question 5

1. Due to the economic crisis, the turnover rate of new employees is very high. You are the person in charge of training new biomedical equipment technicians. Write an outline of an instruction manual for a biomedical equipment technician on how to reduce noise. NOTE: Only write things that are relevant to biomedical equipment technicians. (2 marks)
2. Briefly explain each of the following in regards to signals. (2 marks)
 - a) Signal to noise ratio (SNR)
 - b) Aliasing (2 marks)

3. Assume that someone you knew got electrocuted at his/her workplace. What would be the safety issue that was neglected in this case? (2 marks)
4. Answer the following questions based on the circuit in Figure Q4. Assume ideal Op-Amps.
- Briefly explain the functions of the Op-Amps shown as A_1 , A_2 and A_3 .
 - State the input voltage to the negative terminal of the Op-Amp A_1 . Show workings and/or give reasoning.
 - State the difference in output voltages V_1 and V_2 of Op-Amps A_1 and A_2 respectively. Show workings and/or give reasoning. You may state and use any assumptions regarding the resistors to simplify your answer.

(6 marks)

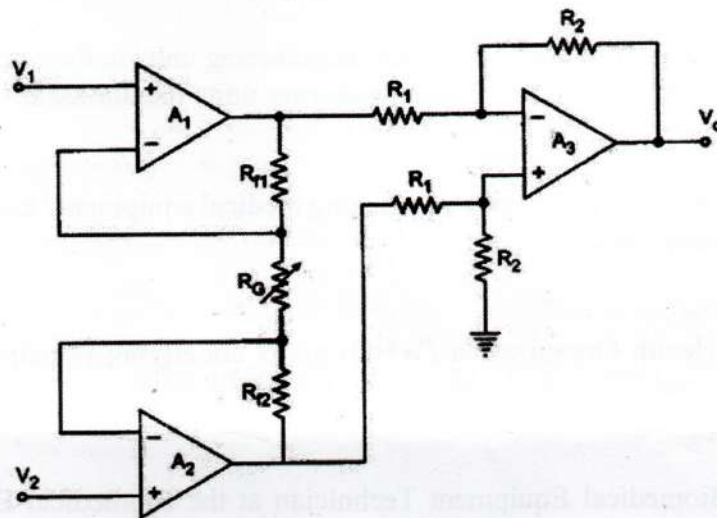


Figure Q4: Circuit