

**ROYAL CIVIL SERVICE COMMISSION  
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2022  
EXAMINATION CATEGORY: TECHNICAL**

**PAPER III: SUBJECT SPECIALISATION PAPER FOR BIOMEDICAL ENGINEERING**

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<b>Date</b>	: October 9, 2022
<b>Total Marks</b>	: 100
<b>Writing Time</b>	: 150 minutes (2.5 hours)
<b>Reading Time</b>	: 15 Minutes (prior to writing time)

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**GENERAL INSTRUCTIONS:**

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A & SECTION B:
  - **SECTION A** has two parts: Part I - 30 Multiple Choice Questions  
Part II - 4 Short Answer Questions  
All questions under SECTION A are **COMPULSORY**.
  - **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions of your choice.
4. All answers should be written on the Answer Booklet provided to you. Candidates are not allowed to write anything on the question paper. If required, ask for additional Answer Booklet.
5. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating the Section, Part and Question Number will NOT be evaluated and no marks will be awarded.
6. Begin each Section and Part in a fresh page of the Answer Booklet.
7. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
8. Use of any other paper including paper for rough work is not permitted.
9. **You must hand over the Answer Booklet to the Invigilator before leaving the examination hall.**
10. This paper has **7 printed pages**, including this instruction page.

**GOOD LUCK**

SECTION A

PART I: Multiple Choice Questions [30 marks]

Choose the correct answer and write down the letter of your chosen answer in the Answer Booklet against the question number e.g. 31 (d). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. Where is the bacterial filter located in an anesthesia machine?
  - a) Inspiratory side
  - b) Expiratory side
  - c) In between inspiratory and expiratory side
  - d) None of the above
  
2. What does X stand for in the word 'X-ray'?
  - a) X-radiation used to signify extra powerful type of radiation.
  - b) X-radiation used to signify unknown type of radiation.
  - c) X-radiation used to signify extreme type of radiation.
  - d) X-radiation used to signify extra wavelength of radiation.
  
3. What is the types membrane used in dialyzer of dialysis machine?
  - a) Fiber optic membrane.
  - b) Hollow fiber and layered membrane.
  - c) Hollow fiber or layered membrane.
  - d) Semipermeable membrane.
  
4. EMG is an instrument used to measure electrical activity of \_\_\_\_\_.
  - a) muscles
  - b) brain
  - c) skin
  - d) None of the above
  
5. What is the cause of light or dark recording of EEG?
  - a) Pen is not touching properly.
  - b) Ink tubes are clogged.
  - c) Incorrectly loaded paper.
  - d) Lead connection problem.
  
6. Which one of the following is an active element?
  - a) 10mH inductor
  - b) 10V power supply
  - c) 25 pF capacitor
  - d) None of the above
  
7. Palsied muscle mean \_\_\_\_\_.
  - a) paralyzed muscle
  - b) active muscle
  - c) voluntary muscle
  - d) involuntary muscle

8. Electrooculography (EOG/E.O.G) is a technique used for measuring \_\_\_\_\_.
- abnormal functioning of retina.
  - pupil dilation rate.
  - cornea pressure.
  - cornea-retinal standing potential.
9. Which one of the following metals is preferred for manufacturing of micro electrodes?
- Silver
  - Copper
  - Tungsten
  - None of the above
10. What is the function of electrode paste?
- Increase contact impedance.
  - Reduce contact impedance.
  - Absorb contact impedance.
  - Balance contact impedance.
11. The respiratory system in human body is what kind of system from a point of view of an equipment?
- Hydraulic
  - Mechanical
  - Biological
  - Pneumatic
12. Which one of the following instruments is used to record the sound of pumping of the heart?
- ECG
  - PCG
  - VCG
  - CTG
13. Which instrument is used for clinical detection of heart sound?
- Stethoscope
  - Anoscope
  - Proctoscope
  - Endoscope
14. Blood pressure can be measured in how many ways?
- One
  - Two
  - Three
  - Six
15. In an infant, the pulse oximeter cuff is attached to their \_\_\_\_\_.
- arm
  - finger
  - foot
  - palm

16. The method based on the absorption of radiation of a substance is known as \_\_\_\_\_.
- absorption photometry.
  - absorption tonometry.
  - absorption spectrophotometry.
  - absorption cytometry.
17. In photometers, the reading of a specimen is obtained initially in the form of which one of the following parameters?
- Transmittance
  - Adsorption
  - Absorption
  - Transcription
18. The main five types of occupational hazards in hospitals are
- Physical, Chemical, Biological, Ergonomic, Psychological
  - Physical, Chemical, Electrical, social, Electronic
  - Physical, Psychological, Ergonomic, Biological, Dust
  - Physical, Chemical, Fungal, Radiation, Dust
19. The most common crystals used in recent times in ultrasound machine is
- quartz.
  - PZT (Lead Zirconate Titanate).
  - titanium.
  - diamond.
20. The device that reverses the fibrillation of the heart is \_\_\_\_\_.
- ECG
  - Holter machine
  - Defibrillator
  - ventilator
21. The types of pacemaker includes
- external and internal.
  - manual and automatic.
  - inferior and superior.
  - basic and advance.
22. The average pressure exerted by the blood on the artery during the complete cycle of ventricles contracting and relaxing is called
- average airway pressure.
  - arterial ventricle pressure.
  - mean airway pressure.
  - None of the above

23. The ability of the body to balance the heat produced in the body with the heat lost by the body thereby maintaining the body temperature in the normal range is called
- Hypothermia
  - Hyperthermia
  - Hypo regulation
  - None of the above
24. Method by which the anesthetic gases wastes and vapors are eliminated from the operating theatre room is called
- medical gas waste scavenging system.
  - anesthetic gas scavenging system.
  - anesthetic gas waste scavenging system.
  - medical gas scavenging system.
25. Which one of the following instruments is used to measure blood flow in the skin?
- NMR Blood Flowmeter
  - Ultrasonic Blood Flowmeter
  - Electromagnetic Blood Flowmeter
  - Laser Doppler Blood Flowmeter
26. The full form of ABG in ABG analyzer machine is
- Arterial Blood Gas.
  - Artificial Blood Gas.
  - Artery Blood Gas.
  - None of the above
27. The device that operates by swinging is called
- Pendulum
  - Centrifuge
  - Rotating anode
  - Rotating tube
28. What will happen if the patient electrode is not placed properly while using electrosurgical unit?
- Machine will not work
  - Patient will suffer burn injury
  - Machine will get spoilt
  - Patient will die
29. What is the proper way to use screwdriver while using on screws?
- 70 % turn, 80% force
  - 50% turn, 50% force
  - 80% turn, 20% force
  - 20% turn, 80% force
30. What device is used to test the electrical safety of a medical equipment?
- Electrical safety analyzer
  - Electrical safety simulator
  - Electrical safety device
  - Electrical safety multi-meter

**PART II – Short Answer Questions [20 marks]**

**This part has 4 Short Answer Questions. Answer ALL the questions. Each question carries 5 marks.**

1. Define assets management in biomedical engineering? What are the inclusions that are to be included while taking an inventory of medical equipment? **(2+3 marks)**
2. Wheel chair is an assistive device and not a medical equipment. True/False? Draw and label the components of a wheel chair. **(1+4 marks)**
3. What is the use of anesthesia machine? Name and explain three basic types of anesthesia categories? **(2+3 marks)**
4. a) What is medical imaging? b) What are the commonly used technologies in medical imaging? **(2+3 marks)**

**SECTION B: Case Study [50 marks]**

**Choose either Case I or Case II from this section. Each case study carries 50 marks. Mark for each sub-question is indicated in the brackets.**

**CASE I**

You are newly appointed Biomedical Engineer at the Regional Referral Hospital in Bhutan. The hospital has plans to upgrade a dialysis unit at the hospital. As a technical expertise you are assigned to lead the project for Dialysis unit upgradation at the hospital. You are asked to work with the team comprising of Doctors, Nurses, Electrical Engineer, Civil Engineer, Administrative officer, Procurement officer, and Finance officer to come up with a complete structural and functional plan for dialysis unit.

1. Explain your role as a biomedical engineer in the hospital in detail? **(5 marks)**
2. Explain with diagram how the dialysis machine works? **(10 marks)**
3. What is pre-installation requirement? Is pre-installation required for dialysis machine? If yes, what are the pre-installation requirements for dialysis machine? **(10 marks)**
4. The procurement officer wants you to submit the requirements for the unit. a) What will you do before submitting the list of dialysis machine? b) List down all the requirements in detail for submitting to the procurement officer? **(5+ 5 marks)**
5. Develop standard operating guideline for dialysis machine? **(10 marks)**
6. What is your role as biomedical engineer after completion of the assigned work? **(5 marks)**

**CASE II**

You are newly appointed at one of the hospitals in Bhutan as a Biomedical Engineer. You are the first engineer to be appointed at that hospital so the management and the staffs are not familiar with biomedical engineering services. You are asked to prepare a short presentation to introduce yourself and to familiarize the hospital with your roles and responsibilities. At the end of the presentation the hospital has arranged for a question-and-answer session to get to know your role in detail. Here are some of the questions asked;

1. What is biomedical engineering? What does the biomedical engineer do in a hospital? **(2+ 5 marks)**
2. a) What are the types of maintenance work that a biomedical engineer carryout? Explain in detail?  
b) List down the tools required for carrying out all types of maintenance? **(10 marks)**
3. What is medical equipment life cycle? Explain in detail with a diagram? **(15 marks)**
4. What is an inventory? Why is it important to keep an inventory of medical equipment? What should be included in an inventory of medical equipment? **(1+2+5 marks)**
5. What type of energy is produced by each of the medical equipment listed below? **(10 marks)**
  - a) Defibrillator
  - b) Ventilator
  - c) X-ray apparatus
  - d) Ultrasound machine
  - e) Infant Incubator

**TASHI DELEK**