ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2024
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALISATION PAPER FOR BIOMEDICAL ENGINEERING

Date : October 5, 2024
Total Marks. :100
Writing Time :150 minutes (2.5 hours)
Reading Time :15 Minutes (prior to writing time)

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. Which equipment is used to heal many kind of cancers?
   a) Magnetic Resonance Imaging
   b) Computer tomography
   c) Radiation therapy
   d) Catheter Angiography

2. The X-ray machines is used as diagnostic equipment in all health centers. The image on the X-ray film is ……..
   a) Rare image
   b) Shadow image
   c) Real image
   d) All of the above

3. In a human cardiovascular system the arteries carry
   a) Oxygenated blood towards the heart
   b) Deoxygenated blood towards the heart
   c) Deoxygenated blood away from the heart
   d) Oxygenated blood away from the heart

4. From an equipment point of view the respiration system in the human body is …….
   a) Pneumatic system
   b) Bidirectional system
   c) Circulatory system
   d) Exocrine system

5. The source of biomedical signal for the pulse oximetry i. e pulmonary system is ……..
   a) Bio electric
   b) Bio impedance
   c) Bio optical
   d) Bio mechanical

6. ……. is used to convert one form of energy to another, this sensor is used in most of the medical equipment
   a) Transducer
   b) Transformer
   c) Thermistor
   d) All of the above

7. Which method or principle does portable oxygen concentrator use to separate air from oxygen?
   a) Pressure drop adsorption
   b) Pressure swing adsorption
   c) Pressure swing absorption
   d) Pressurized air absorption

8. LFT and RFT blood tests are processed in which machine?
   a) Immunochemistry analyzer
   b) Hematology analyzer
   c) Electrolyte analyzer
   d) Biochemistry analyzer

9. The document 60601-1-1 standard developed under IEC is for
   a) Safety of medical electrical equipment
   b) Safety requirements for medical electrical system
   c) Safety requirement for medical equipment
   d) Safety requirement for medical system

10. Non-isolated applied part based on degree of protection is
   a) Type BF
   b) Type B
   c) Class I
   d) Class II

11. The normal EEG range is between
   a) 5-20Hz
   b) 5-30Hz
   c) 5-40Hz
   d) 5.50Hz

12. Which kind of amplifier is used in the ECG recording system?
   a) Isolation amplifier
   b) Electronic amplifier
   c) Differential amplifier
   d) Bridge amplifier

13. How do you maintain an MRI machine?
   a) The magnet system is checked for condensation
   b) Magnet pressure gauge is inspected
   c) Helium level is inspected
   d) All of the above

14. What is used to measure respiratory volume?
   a) Echo Cardiography
   b) Ultrasound technique
   c) Spirometry
   d) Thermo-dilution technique

15. The X-ray beam penetration through the patient can be increased by increasing
    a) mAs
    b) kV
    c) Beam area
    d) Kv and mAs

16. Auto acoustic emission that are tested in OAE machine in audiology is sound emitted from the
    a) Eardrum
    b) Ossicles
    c) Cochlea
    d) Vestibular nerves

17. In the air, at 20 degree Celsius and at sea level, sound travel at the speed of
    a) 340m per second
    b) 324m per second
    c) 344m per second
    d) 355m per second

18. ABG machine in ICUs are used mainly to evaluate
    a) Patient ventilation
    b) Patient blood
    c) patient consciousness
    d) all of the above

19. What are the anesthesia gas used in the anesthesia machine for the operating procedure?
    a) Isoflurane
    b) Sevoflurane
    c) Halothane
    d) All of the above

20. The filter used to reject the 50Hz noise picked up from the power line is called?
    a) Band stop filter
    b) Notch filter
    c) Band gate filter
    d) All of the above

21. In the medical equipment where the electrode paste or gel is used to ……..
    a) Absorb contact impedance
    b) Equate contact impedance
    c) Reduce contact impedance
    d) Increase contact impedance

22. Optical fiber sensor are electrically……..
    a) Passive
    b) Active
    c) Active as well as passive
    d) Cannot be determined

23. What are used as light sources in the skin reflectance oximeter?
    a) Red and infrared LED
    b) Photodiode
    c) Infrared and ultra-red LED
    d) Red and blue LED

24. What is incorporated in the sensor to warm the tissue so as to increase local blood flow?
    a) Thermostat
    b) Heating plate
    c) Heater
    d) Thermometer

25. …….uses high-frequency electromagnetic energy to generate heat
    a) longwave diathermy machine
    b) Shortwave diathermy machine
    c) Diathermy machine
    d) TENS Machine

26. The PCR machine is used to detect COVID-19, what does PCR machine mean
    a) Polyester chain reaction
    b) Polymers Chain reaction
    c) Polymerase Chain reaction
    d) Polyser Chain reaction

27. What does ND: YAG laser uses
    a) Far infrared wavelength
    b) Far micro wavelength
    c) Near infrared wavelength
    d) Near ultraviolet wavelength

28. In which field the Orthopantomogram is used……
    a) Field of orthopedic
    b) Field of radiology
    c) Field of ophthalmology
    d) Field of dentistry

29. How do you check an IC by using a multi-meter
    a) By placing the selector at ohm symbol
    b) By placing the selector at continuity symbol
    c) By placing the selector at DC voltage indicator
    d) By placing the selector at capacitor symbol

30. What causes metal artifact in CT
    a) Photo starvation
    b) Scattering
    c) Edge effect
    d) All of the above

PART II – Short Answer Questions [20 marks]

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

1. Explain the different equipment classification based on method of protection with example. [**3+2 marks**]

2. In the case there is a breakdown of anesthesia machine, as a field biomedical engineer, how will you carry out the maintenance and resolve the issue? Explain technically.[**3+2 marks**]

3. What is the significance of grounding in the field of medical equipment? Explain its type technically.[**2 + 3 marks**]

4. Explain the importance of equipment management and its impact in the field of medical equipment management.[**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

As a newly appointed biomedical engineer in the hospital you are expected to demonstrate following skills inform of the supervisor.

1. Explain principle of digital radiography and computer radiography to the newly passed-out technician with proper technical components and mechanisms with a block diagram. [**25 marks]**

2. You are placed as a biomedical engineer in a hospital with many high-end ophthalmic equipment. Your work is to conduct PPM and replacement of components for A/B scan. Explain and describe with PPM steps and block diagram. **[25 marks]**

CASE II

You are newly appointed engineer at the Department of Biomedical Engineering. Your first appointment as an engineer is to handle a project related to equipment in OT and Pediatric department. To do so you are first expected to know the detail of following equipment.

1. Explain the mechanism of CPAP used for the neonate patient in the hospital setup. Describe its benefits to the neonate patient undergoing therapy. **[25 marks]**

2. In your hospital there is a newly installed operation microscope for the otolaryngology procedure. You are supposed to train your subordinates after attending the training. Explain the principle and its mechanism with the proper block diagram to make your subordinate understand its overall performance and its clinical benefits using the instrument. **[25 marks]**

TASHI DELEK