ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2023
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALISATION PAPER FOR BIOMEDICAL ENGINEERING

Date : October 7, 2023
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 **6 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. _____ camera helps in finding out the physiological change within the respiratory organs
   a) invasive infrared
   b) Respiratory
   c) Digital infrared
   d) Vascular infrared

2. Korotkoff and oscillometry principle is used in
   a) Electroencephalogram
   b) Blood pressure monitoring
   c) Electromyogram
   d) Electrocardiogram

3. MRIs employ powerful magnets which produce a strong magnetic field that forces _____ in the body to align with that field.
   a) Electron
   b) Proton
   c) Neutron
   d) All of the above

4. SCD equipment is used in
   a) ICUs
   b) Emergency
   c) PICU
   d) All of the above

5. Insynchronous sequential Logic Clock Signal can be
   a) Periodic
   b) Digital and analog
   c) Aperiodic
   d) Periodic and Aperiodic

6. Tympanomneter is used to diagnose which part of ear
   a) Middle ear
   b) Inner ear
   c) Outer ear
   d) Cochlea

7. ABR machine is used to diagnose
   a) Ear
   b) Blood
   c) Skin
   d) Nose

8. Blood flow is the source of _____ signal?
   a) Bio impedance
   b) Bio mechanical
   c) Bio Electrical
   d) Bio magnetic

9. Which standard focus on safety of medical Electrical equipment under IEC
   a) 60601
   b) 60601-1-1
   c) 60601-1
   d) 60601-2

10. Based on the method of protection which class has double insulation or reinforced insulation? This medical equipment are without protective earth.
    a) II BF
    b) IICF
    c) I AF
    d) II

11. In ECG the typical amplitude for QRS in normal Heart rate when recorded in the lead 1 position is
    a) 1mVs
    b) 1mV
    c) 0.1 mVs
    d) 0.1Mv

12. Instrument used to monitor instantaneous foetal heart rate and labor activity is called
    a) Cardiotocography
    b) Cardiotocogram
    c) Cardiogram
    d) Fetal monitor

13. Spirometer is used to measure
    a) Bile concentration
    b) Liver capacity
    c) Lung capacity
    d) Blood content

14. Blood gas analyzer is used to measure
    a) WBC
    b) RBC
    c) Electrolyte
    d) pH

15. which Radiological equipment is particularly used for the diagnostic of breast cancer
    a) Digital X-ray
    b) Mammography
    c) Magnetic resonance Imaging
    d) Computer tomography

16. _____ is important imaging radio nuclide used to examine the brain, liver, thyroid, kidney and heart in nuclear medicine.
    a) Iodine-123
    b) Tecnetium- 99m
    c) Millicurie
    d) Gamma rays

17. In ultrasound _____ imaging mode gives one dimension information.
    a) B mode
    b) A mode
    c) CW mode
    d) PW mode

18. The frequency of current used in surgical diathermy is in the range of:
    a) 1-5 MHz
    b) 1-4 MHz
    c) 1-3 MHz
    d) 1-2 MHz

19. In surgical diathermy the electrode used for coagulation is of
    a) Loop type
    b) Needle type
    c) Band type
    d) Ball type

20. What gas is used in Gas Chromatography Mass spectrometer (GCMS) machine for forensic trace evidence analysis?
    a) Helium
    b) Argon
    c) Oxygen
    d) Carbon dioxide

21. _____machine is used to administer mild electrical current to the skin to relieve pain.
    a) Short wave diathermy
    b) Microwave diathermy
    c) TENS
    d) Electrotherapy

22. What is the principle of dialysis?
    a) Osmosis
    b) Diffusion
    c) Ultrafiltration
    d) All of the above

23. What is used in an anesthesia machine to absorb carbon dioxide?
    a) Sodium chloride
    b) Sodium calcium Hydrate
    c) Potassium chloride
    d) Sodium Iodate Hydrate

24. What does the capnography machine measure or diagnose?
    a) Oxygen saturation
    b) Carbon dioxide saturation
    c) Pulse rate
    d) Heart rate

25. Which equipment is used for patient suffering from muscular dystrophy syndrome?
    a) Ventilator
    b) Apheresis
    c) Diathermy machine
    d) Hypothermia machine

26. Liquid medical drugs is administered to patient using which device?
    a) Infusion pump
    b) Pneumatic pump
    c) Syringe pump
    d) Peristaltic pump

27. Choose one of the following test that biochemistry analyzer gives?
    a) Liver function test
    b) COVID-19 test
    c) Complete blood count test
    d) Viral test

28. Which equipment is used for sleep apnea patient?
    a) Continuous Negative Airway Pressure Machine
    b) Continuous Positive Airway pressure Machine
    c) Bilevel Positive Airway Pressure Machine
    d) All of the Above

29. Which equipment is used for the minimal invasive surgery in Operation Theater?
    a) Endoscope
    b) Colonoscope
    c) Gastroscope
    d) Laparoscope

30. In Bhutan what is the commonly used medical gas system in 60 bedded and above hospitals?
    a) Liquid oxygen system
    b) Manifold system
    c) Individual cylinder system
    d) PSA system

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 PACS and DICOM systems. Explain its use in the medical field with examples. (2+3 marks)

2. Draw the block diagram of the digital Thermometer. Explain its technical mechanism. (2+3 marks)

3. What is a high-frequency ventilator? Explain its mechanism. (2+3 marks)

4. Draw the block diagram of dialysis machine and explain its mechanism briefly. (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 Referral Hospital in Bhutan and as a biomedical engineer you are expected to explain the mechanism of two medical equipment to technician in order to make them understand the working principle and its importance in various department in hospital.

1. Describe the working principle and mechanism of the CO2 laser with the help of a block diagram. Explain the application of CO2 laser in medical practice? **(20 + 10 marks)**

2. Draw the schematic diagram of the defibrillator and explain its principle and its mechanism? Explain its importance in medical field with example. **(16 + 4 Marks)**

CASE II

You are newly appointed at National Referral Hospital in Bhutan as a Biomedical Engineer. Your first appointment as an engineer is to develop specifications and install two sets of equipment in the hospital. To do so you are first expected to know the detail description and the mechanism of the machine.

1. Describe and lay down the principle of OCT. Explain in detail with block diagram and note down its use in the medical field. **(10+ 15) marks)**

2. Describe the mechanism of Intensive care multi parameter patient monitor with the help of block diagram and explain all the parameters. Describe and explain the mechanism of central monitoring system with a block diagram. **(10+5+10 Marks)**