

**ROYAL CIVIL SERVICE COMMISSION  
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2020  
EXAMINATION CATEGORY: TECHNICAL**

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

---

<b>Date</b>	: February 27, 2021
<b>Total Marks</b>	: 100
<b>Writing Time</b>	: 150 minutes (2.5 hours)
<b>Reading Time</b>	: 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 the 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 on 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. What does X stand for in the word x-ray?
  - a) X-Radiation was used to signify an extra powerful type of radiation.
  - b) X-Radiation was used to signify an unknown type of radiation.
  - c) X-Radiation was used to signify an extreme type of radiation.
  - d) X-Radiation was used to signify an exact wavelength type of radiation.
  
2. Why does modern type of x-ray use Rotating Anode?
  - a) It allows electron to be focused so that heat energy is spread over a thin area.
  - b) It allows electron to be focused so that heat energy is focused over a narrow area.
  - c) It allows electron to be focused so that heat energy is spread over a smaller area.
  - d) It allows electron to be focused so that heat energy is spread over a wider area.
  
3. Human motions are
  - a) Complex
  - b) Convoluted
  - c) Conical
  - d) Cylindrical
  
4. Cytosol is a gel-like substance that is
  - a) Mostly water
  - b) Mostly ammonia
  - c) Mostly calcium
  - d) Mostly sodium
  
5. The endoplasmic reticulum (ER) is a network of
  - a) Membrane –enclosed muscle
  - b) Membrane –enclosed sacs
  - c) Membrane –enclosed bones
  - d) Membrane –enclosed cells
  
6. Mitochondria are the
  - a) Storehouse of a cell
  - b) Powerhouse of a cell
  - c) Warehouse of a cell
  - d) Watersheds of a cell

7. Letter F in the EEG electrode placement system denotes
  - a) Front
  - b) Face
  - c) Frontal lobe
  - d) Fast
  
8. Normal EEG frequency range is
  - a) 50 - 500 Hz
  - b) 0.5 - 50 Hz
  - c) 0.05 - 5 Hz
  - d) 1 - 200 Hz
  
9. What does biosensors do?
  - a) It detects the user's impulses.
  - b) It detects the user's memories.
  - c) It detects the user's reflexes.
  - d) It detects the user's temperature.
  
10. Mono-polar needle electrode has a coating of which material over the stainless steel wires which is bare only at the tips?
  - a) Carbon
  - b) Calcium
  - c) Sodium
  - d) Teflon
  
11. Blood glucose level measurement device uses a biosensor works on the principle of
  - a) Biosensor
  - b) Chemical
  - c) Electrochemical
  - d) Electronics
  
12. DC amplifiers are employed with \_\_\_\_\_ feedback type.
  - a) positive
  - b) negative
  - c) depends on application type
  - d) None of the above
  
13. Which of the following is the Red Blood Cells?
  - a) Erythrocytes
  - b) Leukocytes
  - c) Basophils
  - d) Monocytes

14. Instruments based on the automatic optical technique takes about \_\_\_\_\_ for completing the count of blood cell.
- a) 30 sec
  - b) 60 sec
  - c) 120 sec
  - d) 50 sec
15. Which of the following is NOT provided by multi-parameter coulter counter?
- a) Mean cell volume
  - b) Red cell count
  - c) Mean cell haemoglobin count
  - d) White cell count
16. What occurs when two or more particles are present in the sensing zone of an analyser machine at the same time?
- a) Calibration
  - b) Troubleshooting
  - c) Delay in result
  - d) Coincidence error
17. What is the total operating range of the transducer called?
- a) Offset
  - b) Threshold
  - c) Span
  - d) Drift
18. Which of the following is NOT the electrolyte?
- a) Bicarbonate
  - b) Potassium
  - c) Magnesium
  - d) Sodium
19. The function of the \_\_\_\_\_ is to continuously and simultaneously push fluids, air and gases through the analytical chain.
- a) sampling unit
  - b) propositioning pump
  - c) manifold
  - d) dialyzer
20. Which of the following two elements are removed by the detection filter in the process of the ECG waveform?
- a) Low frequency noise, motion noise
  - b) Muscle artifact, motion artifact
  - c) Baseline wander, motion noise
  - d) Baseline wander, muscle artifact

21. Which threshold of hearing is measured by a pure-tone audiometer?
- Air-conduction thresholds of hearing.
  - Bone-conduction thresholds of hearing.
  - Speech reception thresholds for diagnostic purposes.
  - Air-conduction and bone-conduction thresholds of hearing.
22. CT stands for?
- Controlled tomography
  - Computed tomography
  - Converted tomography
  - Compression tomography
23. Which method is based on the absorption of radiation of a substance?
- Absorption Endoscopy
  - Absorption Spectroscopy
  - Absorption Arthroscopy
  - Absorption Colonoscopy
24. A model of the normal QRS complex is called
- ECG model
  - QRS model
  - Template
  - Detection model
25. In medical devices, the amplifiers that are used for the amplification purpose of the input signal must have
- low frequency response.
  - high frequency response.
  - average frequency response.
  - frequency response has no role to play in it.
26. Merrick and Hayes (1976) describe details of a \_\_\_\_\_ oximeter which enables the measurement of oxygen saturation of the blood.
- pulse
  - ear
  - skin reflectance
  - All of the above
27. A quartz crystal oscillator consists of
- only series resonant frequency.
  - only parallel resonant frequency.
  - both series and parallel frequencies.
  - neither series nor parallel frequency.

28. Which of the following are the necessary requirements of an oscillator?
- Amplitude stability
  - Frequency stability
  - Power stability
  - Both (a) and (b)
29. Strain gauge is used to measure
- Temperature
  - Pressure
  - Height
  - Displacement
30. Which of the following terms describes the body's ability to maintain its normal state?
- Anabolism
  - Catabolism
  - Tolerance
  - Homeostasis

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

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

- Define bioinstrumentation? Name the most well-known aspect of bioinstrumentation?  
(3+2 marks)
- Explain in detail the MRI technology and how it is used? Can MRI be used for scanning animal's body? (4+1 marks)
- What is the mechanism of ELISA? Name four diseases that can be detected by use of ELISA?  
(1+4 marks)
- Name the machine used for detection of coronavirus? List the essential medical equipments and devices used to treat patients with Covid-19. ( 1+4 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 as biomedical engineer at the Jigme Dorji Wangchuck National Referral Hospital. The hospital is planning to extend the existing operating theatre. In the first OT, the hospital plans to set up for ob-gyn only and the second one for general surgeries. You are assigned to do the following task as follows:

1. List the medical equipments required for both the OT? (10 marks)
2. What will you ask the users while preparing the technical specification list? (5 marks)
3. Consider you have asked the necessary questions for preparing the technical specification. Prepare a detailed technical specification for: (15 marks)
  - a) Ob-gyn operating bed
  - b) General operating bed
  - c) OT light
4. What are the most common types of operating rooms available in modern hospitals? What are the specifications to be considered as a biomedical engineer while planning for an OT? (6+4 marks)
5. What are the roles and responsibilities of biomedical engineer in the hospital? (10 marks)

**CASE II**

You are the biomedical engineer in Mongar Regional Referral Hospital (MRRH). You are assigned to take lead role in establishing an isolation ward with ICU facility for Covid-19 patients. You have to complete the task within a month's time. Answer the following questions based on the aforementioned scenario:

1. What are the requirements should you consider while establishing the facility? Why is there a need for a separate ICU facility for Covid-19 patients? (10 marks)
2. Compile a list of medical equipments required in the ICU facility at the isolation ward? (10 marks)
3. Draw a complete block diagram of ventilator with compressor. (20 marks)
4. What is medical equipment inventory? Why is it important to have an inventory at the hospital during situations like coronavirus pandemic? Write in detail its advantages and disadvantages, if any? (10 marks)

**TASHI DELEK**