

ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2015
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALIZATION PAPER for *Biomedical Engineering*

Date	: 11 October 2015
Total Marks	: 100
Examination Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to examination time)

GENERAL INSTRUCTIONS:

1. Write your Roll Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is being provided 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 and 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 under your choice.
4. 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 any or correct Section, Part and Question Number will NOT be evaluated and no marks would be awarded.
5. Begin each Section and Part in a fresh page of the Answer Booklet.
6. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
7. Use of any other paper including paper for rough work is not permitted.
8. You are required to hand over the Answer Booklet to the Invigilator before leaving the examination hall.
9. This paper has 08 printed pages in all, including this instruction page.

GOOD LUCK!

SECTION A

PART I - Multiple Choice Questions (30 Marks)

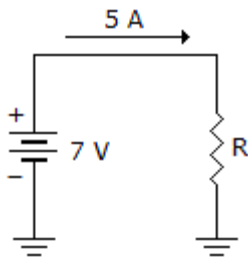
Choose the correct answer and write down the letter of the correct answer chosen in the Answer Booklet against the question number. E.g. 31 (c). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. Chemical ----- is responsible for keeping Body PH stable.
 - a. Buffer
 - b. Component
 - c. Atom
 - d. Compound

2. Sensory receptors (nerve endings) in the skin are called-----
 - a. proprioceptors
 - b. cutaneous receptors
 - c. subcutaneous receptors
 - d. proprioceptors receptors

3. If doubling of voltage across a resistor doubles the current through the resistor then
 - a. The resistor value is decreased
 - b. The resistor value did not change
 - c. Resistor value increase
 - d. None of the above

Use the figure below to answer question No. 4.



4. What is the power in the given circuit?
 - a. 3.6 W
 - b. 35 W
 - c. 1.4 W
 - d. 3.5 W

5. Power is defined as
 - a. Rate at which the work is done
 - b. Work

- c. Conversion of energy
 - d. Joules
6. Ionization within a P-N junction causes a layer on each side of the barrier called
- a. Junction
 - b. Depletion layer
 - c. Barrier voltage
 - d. Forward voltage
7. What is a varistor
- a. a voltage- dependent resistor
 - b. a voltage-dependent diode
 - c. a current-dependent resistor
 - d. a current-dependent diode
8. Since diodes are destroyed by excessive currents, the circuits must have
- a. higher voltage sources
 - b. current limiting resistors
 - c. more dopants
 - d. higher current sources
9. Increasing the number of turns of wire on the secondary of a transformer will
- a. Increase the secondary current
 - b. Decrease the secondary current
 - c. Have no effect on secondary current
 - d. Increase the primary current
10. A NAND gate has:
- a. Low input and low output
 - b. High output and high output
 - c. Low input and high output
 - d. None of the above
11. Which is a typical application of digital signal processing?
- a. Noise elimination
 - b. Music signal processing
 - c. Image processing
 - d. All of the above
12. How are unwanted frequencies removed prior to digital conversion?
- a. Pre- filters
 - b. Digital signal processing
 - c. Sample and hold circuits
 - d. None of the above

13. A +5 V PCB power source that has been "pulled down" to a +3.4 V level may be due to:
- Open circuit
 - Power failure
 - Faulty resistor
 - Short circuit
14. The use of a multi-meter with digital circuits allows the measurement of:
- Pulse width
 - Voltage or resistance
 - current
 - pulse trains
15. What was the biomedical engineering unit under ministry of health termed as during 1980s
- Health equipment repair and maintenance unit
 - Hospital equipment repair and maintenance unit
 - Health equipment repair unit
 - Hospital equipment repair unit
16. Biomedical engineering division is under which department of ministry of health
- Department of medical supplies
 - Department of public health
 - Department of medical supplies and health infrastructure
 - None of the above
17. BES office in CRRH, Gelephu serves as the regional office for _____ region
- Western
 - Eastern
 - Central
 - Southern
18. The ultrasound transducer are _____ of the ultrasonography machine
- Heart
 - Consumable
 - Spare part
 - Accessory
19. Ad-hock maintenance of a medical equipment is maintenance
- On request
 - Emergency maintenance
 - Planned maintenance
 - All of the above

20. Following are the components of medical equipment life cycle management except
- Training
 - Decommissioning
 - Installation
 - Reinstallation
21. Interferential machine would belong to which department in a hospital
- Surgical department
 - Pediatric department
 - Physiotherapy department
 - Dental department
22. Reverse osmosis system in hospital is used for
- Purification of blood
 - Purification of water
 - Transportation of water
 - None of the above
23. A blood gas analyzer measures_____
- pH, K and Cl
 - pCo₂,pO₂ and Na
 - pH,Pco₂,pO₂
 - All of the above
24. Active response to an altered environment that results in reduced function or size of cell or organ is
- Atrophy
 - Aging
 - apoptosis
 - all of the above
25. Specialization of biomedical engineering which deals with environmental controller is
- Clinical engineering
 - Biomechanical engineering
 - Biomaterial engineering
 - Rehabilitation engineering
26. An artificial device used to replace the missing body part which maybe lost through trauma, disease or congenital condition is
- Orthosis
 - Prosthesis
 - Orthotics
 - Prosthetics

27. The applied part are classified as:
- Type I,II,III,IV
 - Type A,B,CF
 - Type B,CF,BF
 - None of the above
28. Current fluctuation is very frequent in Bhutan which leads to frequent equipment breakdown, what will you check in such situation and what will be the voltage rating?
- Voltage input of 220-240vV
 - Voltage output of 220-240V
 - Input output voltage of 240V
 - Voltage input of 240v
29. The normal average pulse of an adult male is
- 60-100 bpm
 - 80-100bpm
 - 100-120bpm
 - 60-80bpm
30. Tocodynamometer is a part of which machine?
- Interferential machine
 - Ultrasonography
 - Echocardiography
 - CTG machine

PART II – Short Answer Type Questions (20 Marks)

Answer ALL the questions. Each question carries 5 marks. Mark for each sub-question is indicated in the brackets.

1. Explain briefly the different types of maintenance contract awarded for the repair and maintenance of medical equipment in Bhutan. (5 marks)
2. Name the commonly used procedure in Bhutan for the diagnosis of peptic ulcer. What is the name of machine associated with the procedure? Name the components of such machine. Mention the risk level. (1+1+2+1)
3. Give a diagrammatic explanation of respiratory system. Name at least four devices that are used to monitor and measure the respiratory rate in humans. (3+2)
4. Define occupational health and safety? What are the types of hazards found at the hospital, explain with at least six examples. (2+3)

SECTION B

Case Study

Choose either Case 1 or Case 2 from this Section. Each Case carries 50 marks. Mark for each sub-question is indicated in the brackets.

CASE 1

The Ministry of Health has recruited a biomedical technician for regional referral hospitals in Bhutan. You as a biomedical engineer is assigned to train the technician on repair and maintenance of ventilator machine at the hospital. Explain

- a) Explain/define the three basic types of medical equipment available in the country (5 marks)
- b) Define the term
 - i) Volume controlled mode (1 mark)
 - ii) pressure controlled mode (1 mark)
 - iii) spontaneous/assisted mode (1 mark)
 - iv) PEEP (1 mark)
 - v) CMV (1 mark)
 - vi) SIMV (1 mark)
 - vii)CPAP (1 mark)
- c) Explain following:
 - i) planned preventive maintenance (2 marks)
 - ii) corrective maintenance (2 marks)
 - iii)ad-hoc maintenance (2 marks)
 - iv)emergency maintenance (2 marks)
- d) Draw a block diagram for the ventilator machine and briefly explain its component (30 marks)

CASE 2

- a) Explain your role as a biomedical engineer in Bhutan if you are
 - i) assigned as a member of an evaluation team (5 marks)
 - ii) assigned as a member of quality inspection team (5 marks)
 - iii) during installation of medical equipment (5 marks)
 - iv) condemnation of medical equipment (5 marks)
- b) You are assigned to lead the biomedical engineering unit at the regional referral hospital. Explain in detail the following

- i) What will be your job responsibilities as a biomedical engineer? (10 marks)
- ii) What will be the medical equipment life cycle at the hospital and explain each step? (10 marks)
- iii) What is medical equipment inventory? Is important to have an inventory at the hospital? Write in detail its advantages or disadvantages. (10 marks)

