

ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2010
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALIZATION PAPER FOR BIOMEDICAL ENGINEERING

Date : 24th November 2010
Total Marks : 100
Examination Time : 2.5 Hours
Reading Time : 15 Minutes (Prior to exam. Time)

INSTRUCTIONS

1. Write your roll Number clearly on the answer booklet in the space provided.
2. The first 15 minutes is being provided to check the number of pages, printing errors, clarify doubts and to read the instructions. You are **NOT PERMITTED TO WRITE** during this time.
3. Use either **Blue** or **Black** ink pen or ball point pen for the written part and **H.B. Pencils** for the sketches and drawings.
4. All answers should be written on the Answer Booklet provided. Candidates are not allowed to write anything on the question paper.
5. This Question Booklet consists of 6 pages. It is divided into two sections – namely **SECTION A** and **SECTION B**.
6. **SECTION A** consists of two parts. **Part I** and **Part II**.

Part I consists of 30 multiple choice questions carrying one (1) mark each and is compulsory. The answer of your choice should be clearly written in whole along with the question and option number on your answer booklet.

Part II consists of four (4) short answer questions of five (5) marks each and all questions are compulsory.
7. **SECTION B** consists of two **Case Studies**. Choose only **ONE** case study and answer the questions under your choice. Each case study carries fifty (50) marks in total.

PART I – MULTIPLE CHOICE

Section A

Part I: Multiple Choice questions (1 mark each)

Choose the correct Answer and write down the question number and the letter of the correct answer chosen against it in the answer sheet provided.

1. Electroencephalogram (EEG) is used to record;
 - a. Muscle activity
 - b. Cardiac activity
 - c. Brain activity
 - d. Electric energy

2. Instrument used to detect the arterial pulse and pulse pressure waveforms in the extremities are called;
 - a. Sphygmomanometers
 - b. Plethymograph
 - c. Flow meter
 - d. Electrocardiographs.

3. The pressure in the pipeline system of an anesthetic machine is;
 - a. 60 PSI
 - b. 4 BAR
 - c. 400Kpa
 - d. All of the above

4. Type CF equipment is the degree of protection for the patient against electric shock for
 - a. Applied parts
 - b. Allowable leakage current with earthing insulation
 - c. Allowable leakage current and having a F type applied part
 - d. None of the above

5. The Phases of C.T image formation are;
 - a. Data Acquisition
 - b. Image reconstruction
 - c. Image display
 - d. All of the above

6. In a digital circuit, two inputs are 'O' and 'I'. First the two inputs are fed into a 'NAND' gate. Then the output is fed into a 'NOR' gate with another input of 'O'. The final output is;
 - a. O
 - b. I
 - c. NA
 - d. None of the above

7. Given the time frame of 100 seconds, what would be the equivalent frequency;
 - a. 0.05 Hz
 - b. 0.001 Hz
 - c. 0.01 Hz
 - d. 0.005 Hz

8. One of the following is a feature of '3G' technology;
 - a. SMS
 - b. VOIP
 - c. MMS
 - d. TDD

9. The wavelength (λ) in an electromagnetic radiation is denoted by;
 - a. Velocity / speed of light
 - b. Energy of an wave / Velocity
 - c. Speed of light / Velocity
 - d. Speed of light / Energy of an wave

10. The blue light used in phototherapy has a wavelength in the range of;
 - a. 300 - 400 nm
 - b. 400 - 500 nm
 - c. 500 - 600 nm
 - d. 600 - 700 nm

11. Identify one of the golden rules in operational amplifiers.
 - a. The inputs draw no current
 - b. The input draw maximum current
 - c. The output attempts to stabilize the output voltage
 - d. The output sits idle irrespective of difference in input voltage

12. Which memory can be selectively erased and reprogrammed electrically, while in circuit?
 - a. EPROM
 - b. ROM
 - c. EEPROM
 - d. RAM

13. Oxygen sensor is a component of which of the following machine;
 - a. Capnograph
 - b. Pulse Oximeter
 - c. Ventilator
 - d. Cautery machine

14. Interferential machine would belong to which department in a hospital;
 - a. Surgical Department
 - b. Physiotherapy Department
 - c. Pediatric Department
 - d. Dental Department

15. Doppler Ultrasound provides information about;
- Two dimensional image of the body area being examined
 - Frequency generated by the transmitted and receiver transducer
 - Shape, size and location of the organ being examined
 - Blood flow – Its direction and speed
16. Which of the following amplifier would be used in an electrocardiograph machine?
- Ac coupled amplifier
 - Carrier amplifier
 - DC amplifier
 - Chopper input dc amplifier
17. The instrument which carries out a continuous and simultaneous recording of the instantaneous foetal heart rate and labour activity is called;
- Foetal Doppler
 - Cardiotocograph
 - Foetal Monitor
 - Pulse Oximeter
18. Which of the following telemedicine application is used to obtain an expert opinion on the biopsy reports from specialists?
- Teleradiology
 - Telecardiology
 - Telepathology
 - Tele-education
19. In an IC regulator, what does 7812 denote?
- IC pin number and type
 - Companies identification code
 - Positive regulator and voltage
 - Negative regulator and voltage
20. A medical equipment used in America is brought to Bhutan. What device is necessary to make it functional?
- UPS
 - Stabilizer
 - Step up transformer
 - An American operator
21. Total Lung Capacity (TLC) is given by;
- Expiratory Reserve Volume + Residual Volume
 - Vital Capacity + Residual Volume
 - Functional Residual Capacity – Residual Volume
 - None of the above
22. An instrument which isolates monochromatic radiation in a more efficient and versatile manner than colour filters used in filter photometers is;
- Spectrophotometer
 - Photometer
 - Colorimeter
 - Monochromators

- 23 A blood Gas Analyzer measures;
- pH, K and Cl
 - pCO₂, pO₂ and Na
 - pH, pCO₂, and pO₂
 - All of the above
- 24 The human ear responds to vibrations ranging from
- 200 to 2000 Hz
 - 2000 to 20,000 Hz
 - 20 to 20,000 Hz
 - 20,000 to 200,000 Hz
- 25 Which of these is a type of a leakage current?
- Enclosure leakage current
 - Earth leakage current
 - Patient leakage current
 - All of the above
- 26 The target or the anode of an X-ray tube is made of;
- Copper
 - Nickel
 - steel
 - Tungsten
- 27 Which of the following batteries is preferred to be used in the current pacemakers?
- Mercury Battery
 - Lithium iodine battery
 - Nickel cadmium rechargeable battery
 - Nuclear battery
- 28 The frequency of currents used in surgical diathermy units is in the range of;
- 1 – 3 MHz
 - 1 – 300 KHz
 - 1 – 30 GHz
 - None of the above
- 29 The fundamental wavelength of Nd-YAD Laser is;
- 564 nm
 - 1064 nm
 - 2342 nm
 - 3456 nm
- 30 The main difference between TQM (Total Quality Management) and Six Sigma is;
- The approach
 - The rating
 - The procedure
 - The result

Section A

Part II: Short Answers (5 marks each)

1. What are the possible reasons to replace medical equipment? What would happen if there are no condemning and disposal policies in place?
2. What are the indications for use of incubators? How many types of incubators are available in the market?
3. Medical equipment should be safe and reliable so that the patients could be properly diagnosed and treated. What measures need to be taken so that users of medical equipment are not subject to legal, moral and ethical issues in their practices?
4. What is a ventilator? What are the types of ventilator? In your own words, explain the following ventilator terms:
 - a. Positive End Expiratory Pressure (PEEP)
 - b. Conventional Mechanical Ventilation (CMV)
 - c. Synchronized Intermittent Mandatory Ventilation (SIMV)
 - d. Continuous Positive Airway Pressure (CPAP)

Section B

Case Studies (50 marks) Answer only ONE question

1. The Royal Institute of Health Sciences is developing its academic curriculum for its radiography technician's course. You as a biomedical engineer have been asked to submit the following to be introduced into their curriculum.
 - a) A complete block diagram of an X-ray machine with detailed explanation of these blocks / Components.
 - b) The type of X-ray machines required at various levels of health centers.
 - c) A layout diagram of an typical X-ray room with equipment
 - d) A detailed explanation on the following X-ray machines:
 - I. dental X-ray machine
 - II. portable X-ray machine
 - III. mammographic X-ray machine
2. A training has been organized by the Biomedical Engineering Services under the Department of Medical Services to create awareness on the sustainability and management of healthcare technology and medical equipment in the country. You have been asked to present the following in detail:
 - a) Illustrate the various stages of a medical equipment life cycle and explain in detail each stage?
 - b) Which stages in your opinion are being implemented in Bhutan and which stage (s) need to be strengthened?
 - c) Draw and describe the medical equipment iceberg syndrome?
 - d) Mention the ways and reasons for condemning a medical equipment
 - e) What in your opinion can be done to enhance the effective management of our medical equipment, so that health care services can become affordable and sustainable?