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

## PAPER III: SUBJECT SPECIALISATION PAPER FOR RADIOLOGY AND IMAGING SCIENCE TECHNOLOGY

**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 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 & 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. Which of the following occurs as the result of filtration of X- rays?
   I. Harden the X-ray beam
   II. Increase the quality of the X-ray beam
   III. Remove high energy X-rays from the beam
   a) I and II
   b) I and III
   c) II and III
   d) All of the above

2. The most useful type of X- beam in medical imaging is
   a) produced from K-shell of the tungsten anode.
   b) produced from L-shell of the tungsten anode.
   c) produced from M-shell of the tungsten anode.
   d) produced from N-shell of the tungsten anode

3. Which of the process is responsible for the production of electrons at cathode in an X-ray tube?
   a) Induction
   b) Thermionic emission
   c) Electromagnetic induction
   d) Superconducting emission phenomenon

4. Which of the following will help reduce exposure to the patient?
   I. High KV,low mAs
   II. Collimation
   III. Filltration
   a) I and II only
   b) I and III only
   c) II and III only
   d) I, II and III

5. Doubling the distance from 3 feet to 6 feet from the source of X-ray will decrease the radiation dose by a factor of
   a) 1/2
   b) 1/4
   c) 1/8
   d) 1/12

6. Which of the following X-ray beam possess the highest quality?
   a) 70 KV with 2.0 mm Aluminum filter
   b) 80 KV with 1.5 mm Aluminum filter
   c) 85 KV with 2.5 mm Aluminum filter
   d) 90 KV with 3.0 mm Aluminum filter

7. Radiation from the tube housing other than the primary beam is
   a) Secondary.
   b) Compton.
   c) Remnant.
   d) Leakage.

8. The number of structural lines actually recorded within a radiographic image is known as
   a) quality.
   b) contrast
   c) visibility
   d) resolution

9. Which of the following is Grid Frequency?
   a) Ratio of lead strip height into interspace thickness
   b) Ratio of lead strips height to lead strip thickness
   c) Speed of the reciprocating grid
   d) Number of lead strips per inch

10. If a Radio Technologist left a sick patient unattended and he/she fell off the X-ray table and sustained a serious injury, the Technologist could be sued for
    a) felony.
    b) battery.
    c) negligence.
    d) reasonable care.

11. When a patient reacts to an intravenous injection, the Technologist should immediately?
    a) Send for the radiologist
    b) Inject adrenaline
    c) Elevate the head
    d) Attach oxygen

12. The crest of the ilium is at the same level as which of the following vertebrae?
    a) L1 and L2
    b) L2 and L3
    c) L3 and L4
    d) L4 and L5

13. Which of the radiation safety concepts DO NOT apply to diagnostic radiography?
    a) Time
    b) Distance
    c) Shielding
    d) Contamination control

14. “Congruence of radiation and optical field” is a quality assurance test performed for which of the following machine?
    a) X-ray
    b) Ultrasound
    c) Computed Tomography
    d) Magnetic Resonance Imaging

15. Common filters used in Computed Tomography (CT) are of Bow Tie design owing to
    a) Patient's age
    b) Patient's height
    c) Patient's weight
    d) Patient's body structure

16. What is the window period for a stroke patient?
    a) 1 hour
    b) 2 hours
    c) 3 hours
    d) 4 hours

17. Which of the following is NOT usually a component of CT stroke protocol?
    a) Inform the Radiologist On call
    b) Do the CT scan of the brain
    c) Give contrast for CT angiography if required
    d) Do delayed scans after 5 minutes for brain imaging

18. Which of the following statements regarding different CT scanner generations are correctly paired?
    a) 1st Generation-Rotate-Translate
    b) 3rd Generation-Rotate Stationary
    c) 4th Generation-Rotate-Rotate
    d) 4th Generation-most commonly used currently

19. Partial Volume artifacts in CT are rectified by
    a) Positioning aids
    b) Beam filtrations
    c) Thin slice acquisition
    d) Respiratory or Cardiac gating

20. Projecting the voxel with the highest attenuation value on every view throughout the volume onto a 2D image is known as
    a) Surface rendering
    b) Minimum Intensity Projection
    c) Maximum Intensity Projection
    d) Three Dimensional Reconstruction

21. Which of the following medications for diabetic patient is contraindicated for contrast enhanced computed tomography (CECT)?
    a) Insulin
    b) Glipizide
    c) Glyburide
    d) Metformin

22. The kilovoltage peak (KVp) used for an adult patient in Computed Tomography scan is
    a) 110
    b) 120
    c) 130
    d) 140

23. If the protons in the patient's body who is undergoing Magnetic Resonance Imaging relaxes by transferring energy to the surrounding space, it is known as
    a) T1 decay
    b) T2 decay
    c) T1 recovery
    d) T2 recovery

24. What type of cylinders should you use to transport cryogens?
    a) Dewar cylinders
    b) Plastic cylinders
    c) Oxygen cylinders
    d) Liquefied Petroleum Gas cylinders

25. In Magnetic Resonance Imaging ( MRI) Patient's anatomy is best given in
    a) Gradient images
    b) T1 weighted images
    c) T2 weighted images
    d) Proton density images

26. Which of the following is an analytical tool or application?
    a) Ultrasound
    b) Radiography
    c) Mammography
    d) MRI spectroscopy

27. Which of the following is the best choice of investigation for Obstructive jaundice?
    a) Plain X-ray
    b) Ultrasonography
    c) Computed Tomography
    d) Endoscopic Retrograde Cholangiopancreatography

28. DICOM is
    a) a software image.
    b) a computer image.
    c) a medical image feature.
    d) an standard medical image format.

29. The type of display workstation used to review images after acquisition and before sending it to the Radiologist for reporting is
    a) Radiologists Workstation
    b) Physician Review Station
    c) Image Management Station
    d) Technologist's Quality Control Station

30. In Digital Radiography a link between the quality of the image and the dose to the detector is shown by
    a) Exposure indicator
    b) Exposure Exhibitor
    c) Exposure parameters
    d) Exposure patient dose

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

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

1. Compare and contrast Deterministic and Stochastic effects of ionizing radiation focusing on their nature, threshold, examples, mechanism and onset **(5 Marks)**

2. a. What is CT stroke protocol (code stroke CT)? **(1 Mark)**
   b. What is the purpose of doing non-contrast CT brain and CT cerebral angiography during Code Stroke CT? (**2 Marks**)
   c. Why do you think MRI is superior to CT in stroke protocol? list down the essential sequences of MRI stroke protocol (**2 Marks)**

3. What is radiography? Draw a labelled diagram of an X-ray tube with a rotating anode. **(5 Marks)**

4. If you were to design an Artificial Intelligence algorithm for Radiology what are the features that you would like to include? What challenges do you think you will face? **(5 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 a Radio-Technologist on duty. The Emergency Physician has referred a patient to your department for various Medical Imaging Services. The patient is a 55 year old female with known history of hypertension and Type-II diabetes. She was brought to the emergency by her relatives for sudden onset of lest sided chest pain. Additionally she is having persistent headache and severe backache which is radiating to her right leg. The physician has requested medical imaging tests such as Chest X-ray PA view, CT Brain, CT Pulmonary Angiography and MRI Lumbar spine.

In the above context, please answer the following questions

1. Describe the preparation steps and imaging technique that you will carry out while doing Chest X-Ray PA view. **(10 Marks)**

2. Describe the imaging technique that you will carry out while doing NCCT brain. **(5 Marks)**

3. What precautions you will take before doing CT pulmonary angiography and why? **(5 Marks)**

4. How will you perform CT pulmonary angiography? **(5 marks)**

5. Describe the preparation steps and the imaging techniques for MRI lumbar spine **(10 Marks)**

6. What do you think the physician is trying to rule out by ordering the above mentioned medical imaging tests? **(5 Marks)**

7. What ethical responsibilities do you have for ensuring accurate and timely imaging result for the patient? **(5 Marks)**

8. What are the radiation safety principles you will follow while doing X-ray and CT of the patient? **(5 Marks)**

**CASE II**

You are working as a Radio-Technologist at JDWNRH. The Ministry of Health has been assigned to look after the planning, purchasing and installation of diagnostic radiographic facilities for a hospital which is going to be built in Gelephu Mindfulness City. The officials from Ministry of Health consults you regarding the radiation regulations within and outside the country and with your expertise in the field they want to bring best and latest diagnostic machines in the city.

In the above context, please answer the following questions.

1. When establishing any radiation facility, what general consideration should be given on its location, layout, room size, shielding, doors, warning signs, waiting area and ventilation? **(8 Marks)**
2. What are the radiation safety principles and elaborate on them? **(9 Marks)**

3. What will be the requirements of room size, wall thickness, console room, viewing window and mobile protective barrier while establishing an X-ray facility? **(10 Marks)**

4. How does a thermoluminescent dosimeter work? **(7 Marks)**

5. What are the dose limits for the public and occupational worker? **(10 marks)**

6. From the three types of X-system (conventional X-ray machine, Computed Radiography, and Digital radiography) which one will you choose for the department and why? **(6 Marks)**

**TASHI DELEK**