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

PAPER III: SUBJECT SPECIALIZATION PAPER for *Radiology & Imaging Science Technology*

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 07 printed pages in all, including this instruction page.

GOOD LUCK!

SECTION A

PART I – Multiple Choice Questions

Choose the correct answer and write down the letter of the correct answer chosen in the Answer Sheet against the Question Number. E.g. 31 (b). Each question carries ONE mark.

1. All electromagnetic radiation:
   a) Travel through the vacuums with a different velocity
   b) Travel in straight lines
   c) Have the same wavelength
   d) Are able to penetrate a bricks wall

2. The emulsion layer of a film consists of:
   a) Calcium Tungstate and polyester
   b) Potassium bromide and gadolinium
   c) Gelatin and silver bromides
   d) Polyester and phenidone

3. Why is carbon fibre selected for the table top of an X-ray table:
   a) High attenuation of the material
   b) Higher absorption of the primary beam
   c) Cool to the touch
   d) Reduces dose when undertaking grid radiography

4. Replenishment of processing solution:
   a) Is activated by the crossover rollers
   b) Ensures chemicals operate at the correct temperature
   c) Prevents chemicals passing to waste
   d) Maintains solution activity

5. What is used to carry out an erase cycle on a CR plate?
   a) Eraser
   b) White light source
   c) Laser
   d) Heat source

6. Which of the following factors does not reduce the contrast of the image?
   a) Collimation
   b) Compression
   c) Use of grids
   d) Air gap technique

7. The thickness of lead aprons is:
   a) 1mm
   b) 2mm
   c) 0.5mm
   d) 0.25mm

8. The first part of the corpus callosum is known as:
   a. Rostrum
   b. Genu
   c. Trunk
   d. Splenium

9. The S.I unit of absorbed dose is:
   a) Becquerel (Bq)
   b) Curie (Ci)
   c) Gray (Gy)
   d) Roentgen (R)

10. Which one of the following does not affect the quality / energy of the X-ray beam:
    a) Atomic number of the target
    b) kV(tube voltage)
    c) mA (tube current)
    d) filtration

11. The following are the advantages of high kVp technique, EXCEPT:
    a) Scatter radiation is reduced
    b) Radiation close to the patient is reduced
    c) mAs can be reduced
    d) heating the X-ray tube is reduced

12. The main source of scatter radiation during any radiological investigation is:
    a) X-ray tube glass envelop
    b) X-ray grids
    c) Patient
    d) Patient table

13. T1 weight MR images are commonly used for getting information about:
    a) Pathology
    b) Morphology
    c) Patho-physiology
    d) Physiology

14. The most important advantage of MRI over other imaging modalities is excellent:
    a) Soft tissue contrast resolution
    b) Bone imaging
    c) Spatial resolution
    d) Signal to nose ratio

15. The ultrasound display mode which has its application in echo cardiography is:
    a) A-Mode
    b) B-Mode
    c) T-M Mode
    d) C-Mode

16. The tube current used for fluoroscopic mode is:
    a) <5mA
    b) 50mA
    c) 100mA
    d) 200mA

17. Inversion recovery pulse sequence in MRI begins with a RF pulse of:
    a) 15^0
    b) 30^0
    c) 90^0
    d) 180^0

18. Motion artifacts in MR Imaging mostly occur along:
    a) Slice encoding direction
    b) Phase encoding direction
    c) Frequency encoding direction
    d) The main magnetic field

19. Spatial resolution of the image in CT is improved with:
    a) Large matrix size
    b) Large pixel size
    c) Increasing detector size
    d) Increasing focal sport size

20. One Tesla equal to:
    a) 10 gauss
    b) 100 gauss
    c) 1000 gauss
    d) 10,000 gauss

21. Which of the following is a factor that differentiates X-ray and Gamma rays:
    a) Electrical charge
    b) Speed in the vacuum
    c) Source of origin
    d) Particulate nature

22. The average speed of ultrasound in soft tissue is:
    a) 450m/s
    b) 1300m/s
    c) 1450m/s
    d) 1540m/s

23. The backing block inside the ultrasound transducer probe:
    a) Dampens the ultrasound pulse
    b) Provides electrical shielding
    c) Tunes the crystal
    d) Excites the transducer

24. Road mapping is a technique used in:
    a) CT
    b) MRI
    c) DSA
    d) Fluoroscopy

25. If a radiographic image requires 40mAs to produce the required density and the mA was set at 400mA, what is the time setting?
    a) 4s
    b) 10s
    c) 0.1s
    d) 0.04s

26. A stochastic effect of ionizing radiation is:
    a) Cataract formation
    b) Leukaemia
    c) Skin erythema
    d) Sterilization

27. Which of the following is not a branch of right coronary artery:
    a) Conus Artery
    b) Sinus node Artery
    c) Marginal Artery
    d) Posterior descending Artery

28. Which of the following is a posterior branches of the aorta:
    a) Lumbar artery
    b) Renal artery
    c) Coeliac artery
    d) Gonadal artery

29. Which of the following is characteristic of a first generation CT images
    a) Detector array
    b) Fan beam
    c) Pencil beam
    d) Rotate geometry

30. Peaking artifact in a CT image is an example of:
    a) Poor image resolution
    b) Poor image uniformity
    c) Poor image linearity
    d) Poor spatial resolution

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. Describe the generation of CT scan and its differences? (5)

2. What is mean by shimming in MRI? Write down the three types of magnet and its properties? (2+3)

3. Draw a neat diagram of the X-Ray film and labels its part. What are the functions of the emulsion? (3+2)

4. Define IVU? Explain the procedure and film timing. (1+4)

SECTION B: Case Study

Chose either case 1 or case 2 from this section. Each case carries 50 marks. Marks for each sub-section are indicated in the brackets.

CASE 1

If you are appoint as a chief radio-technologist in Regional Referral Hospital after passing your civil service examinations. In this context answer the following question.

a. How would you ensure that the staff, patients and public are safe from the medical radiation? (10)
b. When, where, and how did Wilhelm Conrad Roentgen discover X-rays? What is the difference between nonstochastic and stochastic effects of ionizing radiation? (5+5)
c. Name the types of personnel dosimeters used for measuring the individual exposure of the body to ionizing radiation? What are their advantages and disadvantages? (4+6)
d. What is a threshold dose? Describe radiation quantities and their units of measure? (2+8)
e. Describe in detail how you would go about it, if you have been given the task of planning out the design and layout of the infrastructure of the CT unit in the Regional Referral Hospital? (10)

CASE 2

Radiology and Imaging technology is a dynamic field and plays a vital role in diagnosis of the disease and treatment of the patients. The government is planning to include selective radiology services in BHU grade-I. In this context answer the following question.

a. What radiology services you would like to provide in the BHU grade-I and why? (5)
b. What is the principle used in X-ray, Ultrasound, Computed Tomography and Magnetic Resonance Imaging? (10)
c. What are the advantages and disadvantages of X-ray, Ultrasonography, Computed Tomography and Magnetic resonance Imaging? (10)
d. State the main advantages of modern metal tube housing over glass. Why it is not possible to use oil to lubricate the bearings of the X-ray anode? (3+2)
e. What are the advantages of a 16 slice CT scanner over a single slice CT scanner? What is the difference between X-ray and computed Tomography? (3+2)
f. What is the difference between Computed Radiography and Digital Radiography? Explain the type of system utilized for digital imaging. (5+5)
g. What does PACS stand for? What is PACS used for? (2+3)