

**UNIVERSITY OF JAFFNA, SRI LANKA**  
**BACHELOR OF SCIENCE IN MEDICAL LABORATORY SCIENCES**  
**SECOND YEAR FIRST SEMSTER EXAMINATION – SEPTEMBER 2018**

**MLSMT 2144 MEDICAL LABORATORY TECHNOLOGY I**

**Date: 25.09.2018**

**Time: 3 hours**

**ANSWER ALL EIGHT QUESTIONS.**

**ANSWER PARTS A AND B IN SEPERATE ANSWER BOOKS**

**PART A**

**1.**

- 1.1 Define the specific activity of a radionuclide and give its unit. (15 Marks)
- 1.2 In preparation of a 120 mCi of I-123, radiopharmaceutical is chemically bound with 50 mg of NaI.
- 1.2.1 Find the specific activity of I-123 (10 Marks)
- 1.2.2 Find the amount of I-123 in 90 mCi of a sample (10 Marks)
- 1.3 What is meant by carrier free radionuclide? (10 Marks)
- 1.4 Briefly describe the imaging principle of a gamma camera. (40 Marks)
- 1.5 A 8.2 ml vial of Tc-99m Sodium Pertechnetate contains 375 mCi. In a nuclear medicine imaging process 20 mCi of dose is required to a patient. Find the required volume of radiopharmaceutical for this patient. (15 Marks)

**2.**

- 2.1 Briefly describe the Rutherford's model of an atom. (25 Marks)
- 2.2 Give the postulates of Bohr's atomic model. (20 Marks)
- 2.3 List the effects of ionizing radiation used in medicine. (15 Marks)
- 2.4 Give the basic principles strictly followed in radiation protection. (15 Marks)
- 2.5 Briefly explain how Compton effect influences on gamma camera imaging. (25 Marks)

3.

- 3.1 List the radiation sources used in teletherapy machines. (15 Marks)
- 3.2 List the important features of a radiation source which is currently used in teletherapy machines. (20 Marks)
- 3.3 Briefly explain isodose curves used in a radiotherapy treatment planning. (10 Marks)
- 3.4 Give three examples for tissue equivalent materials. (15 Marks)
- 3.5 List the importance of simulation used in radiotherapy. (25 Marks)
- 3.6 Why telecobalt machine always needs radiation protection? (15 Marks)

4.

- 4.1 Briefly discuss the working principle of a free air ionization chamber. (25 Marks)
- 4.2 Briefly explain how thermoluminescence dosimeter works? (20 Marks)
- 4.3 Distinguish between X-ray and gamma ray. (15 Marks)
- 4.4 Give the features of a filament material used in X-ray tube. (25 Marks)
- 4.5 What is meant by "tenth value layer" in radiation attenuation? (15 Marks)

5.

- 5.1 Define radiation absorbed dose and give its units. (20 Marks)
- 5.2 Briefly describe the radiation cell survival curve of a mammalian tissue. (20 Marks)
- 5.3 What is meant by dose fractionation in external beam radiotherapy and give the advantage of it. (20 Marks)
- 5.4 Define tissue weighting factor and give its importance on biological effects of ionizing radiation. (20 Marks)
- 5.5 Give the biological effect of high linear energy transfer radiation on tissues. (20 Marks)

## PART B

6.

- 6.1 List five properties of a Laser beam. (10 Marks)
- 6.2 Briefly discuss the following processes take place when the light transverse through an active medium.
- 6.2.1 Absorption
  - 6.2.2 Spontaneous emission
  - 6.2.3 Stimulated emission (15 Marks)
- 6.3 What is meant by population inversion of an active medium? (10 Marks)
- 6.4 Briefly explain how Laser light interacts with a human tissue? (15 Marks)
- 6.5 How photodynamic therapy (PDT) used in cancer? (30 Marks)
- 6.6 Explain the application of different amount of heat energy of a laser used in medical applications. (20 Marks)

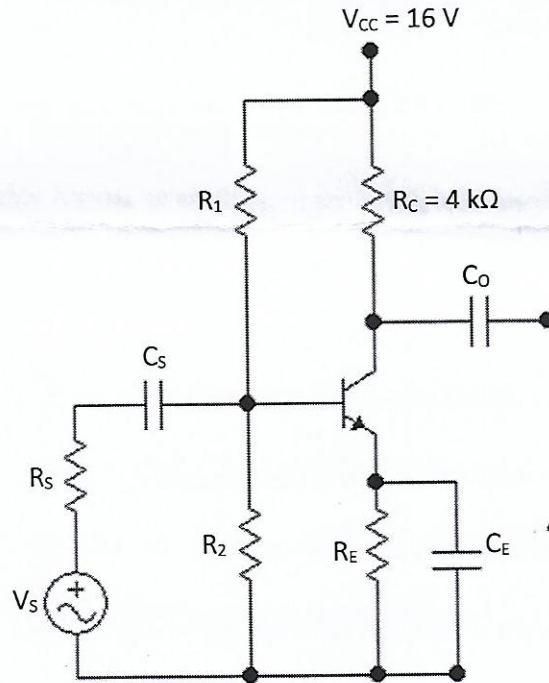
7.

- 7.1 Briefly describe the use of Fluoroscopy in medical applications. (25 Marks)
- 7.2 Describe the functions of the following components of an X-ray tube.
- 7.2.1 Cathode
  - 7.2.2 Anode
  - 7.2.3 Housing (25 Marks)
- 7.3 Describe why is it necessary to maintain the glass/metal envelope of an X-ray tube at vacuum pressure? (10 Marks)
- 7.4 What is meant by the effective focal spot size in X-ray production? (10 Marks)
- 7.5 List the factors influencing on the intensity of X-ray production. (20 Marks)
- 7.6 What is “kV setting” on an X-ray machine console control? (10 Marks)



8.

8.1 The quiescent point of the transistor circuit shown below is set at  $V_{CE} = 7\text{ V}$  and  $I_C = 2\text{ mA}$ .



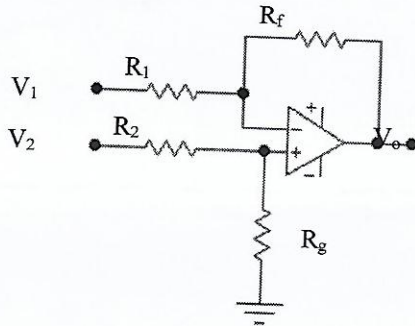
Assuming  $V_{BE} = 0.7\text{ V}$  and  $\beta = 50$ , find the followings.

- 8.1.1 Base current
- 8.1.2 Emitter current
- 8.1.3 Emitter voltage
- 8.1.4 Value of  $R_E$
- 8.1.5 Base voltage
- 8.1.6 Ratio of bias resistance  $R_1 : R_2$

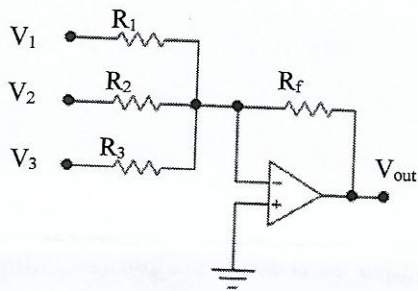
(70 marks)

8.2 In the following circuits, derive an expression for the output signal in terms of resistances and input signals.

8.2.1.



8.2.2



(30 marks)