



UNIVERSITY OF JAFFNA, SRI LANKA
SECOND YEAR FIRST SEMSTER EXAMINATION IN
B.Sc. (HONS.) IN MEDICAL LABORATORY SCIENCES- 2019
MLSMT 2144 MEDICAL LABORATORY TECHNOLOGY I

Date: 22.11.2021

Time: 3 hours

ANSWER ALL EIGHT QUESTIONS.

ANSWER PARTS A AND B IN SEPARATE ANSWER BOOKS

PART A

1.

- 1.1 Distinguish between ionization and non- ionizing radiations. (15 Marks)
- 1.2 List three uses of ionizing radiation other than the use in medicine. (15 Marks)
- 1.3 Give three reasons why ionization radiation is used in medicine? (15 Marks)
- 1.4 Briefly discuss the working principle of X-ray tube with a suitable labeled diagram. (25 Marks)
- 1.5 Briefly describe the different types of X-ray production. (30 Marks)

2.

- 2.1 What is meant by radionuclide generator? (15 Marks)
- 2.2 List four features of radionuclide Tc-99m used in nuclear medicine imaging. (20 Marks)
- 2.3 Briefly explain how bone scan is performed with gamma camera. (30 Marks)
- 2.4 A vial of Ga-67 is stored in a lead shield of 0.7 cm thickness. The exposure rate of unshielded vial is 730 mR/hr. Estimate the exposure rate when the vial is placed in the shield. (You may assume that the Half Value Layer of lead is 0.1 cm) (35 Marks)

3.

3.1 A radiation worker is receiving a radiation exposure rate of 20 mR/hr, when he is standing at distance of 1 m from a patient injected with radioactive substance. If the worker moves to a position of 2 m away from the patient (i.e to 2 m). Calculate the new exposure rate. (20 Marks)

3.2 Briefly explain the working principle of a scintillation detector in the measurement of ionizing radiation. (40 Marks)

3.3 Write short notes on radiation induced chromosomal aberrations. (40 Marks)

4.

4.1 Distinguish between equivalent dose and effective dose in radiation protection.(40 Marks)

4.2 In a year, a radiation worker receives radiation absorbed dose of 8 mGy from internally deposited α particles in lungs and 180 mGy from β particles in thyroid. (You may assume that radiation weighting factors for α and β particles are 20 and 1 respectively. Tissue weighting factors for lung and thyroid are 0.12 and 0.05 respectively)

4.2.1 Estimate the equivalent doses in lung and thyroid. (20 Marks)

4.2.2 Estimate the effective dose of the worker. (20 Marks)

4.3 Briefly describe the deterministic effect of ionizing radiation. (20 Marks)

5.

5.1 Briefly describe the development of different generation of medical linear accelerator. (30 Marks)

5.2 List four advantages of radiation treatment simulation. (20 Marks)

5.3 Distinguish between external beam radiotherapy and brachytherapy. (20 Marks)

5.4 Briefly compare the values of parameters of half-life, specific activity, photon energy, specific gamma ray constant, means of production and half value layer in lead for radionuclides Co-60 and Cs-137 used as teletherapy sources. (30 Marks)

PART B

6.

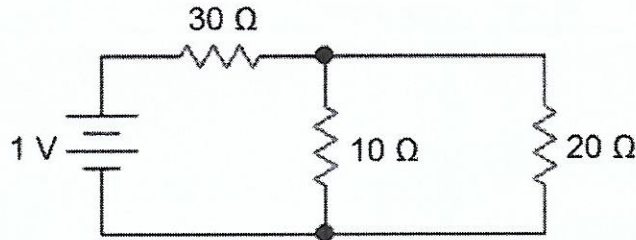
- 6.1 List five unique characteristics of a Laser beam (05 Marks)
- 6.2 Briefly explain how the following processes occur when the light transverse through an active medium.
- 6.2.1 Absorption
- 6.2.2 Spontaneous
- 6.2.3 Stimulated emission (15 Marks)
- 6.3 Give the names of two types of laser modes (10 Marks)
- 6.4 What is meant by population inversion of an active medium? (10 Marks)
- 6.5 Explain briefly, how Laser light interacts with human tissue? (10 Marks)
- 6.6 How photodynamic therapy (PDT) is used for treating tumours? (20 Marks)
- 6.7 Explain the applications of the different amount of heat energy of a laser used in medical applications? (30 Marks)

7.

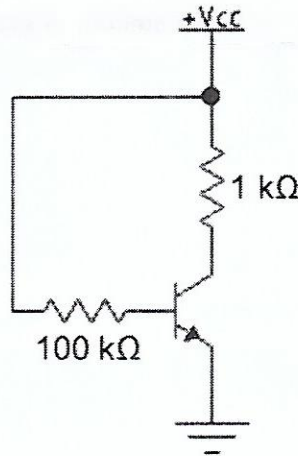
- 7.1 What are the main types of imaging modalities? (25 Marks)
- 7.2 Describe the main functions of the housing of an X-ray tube. (25 Marks)
- 7.3 What are the differences between the actual and effective focal spot size in the area of the target? (20 Marks)
- 7.4 How intensity of the X-ray output produced within an X-ray tube can be adjusted? (20 Marks)
- 7.5 What is the role of kV setting on a console control? (10 Marks)

8.

8.1 The following circuit is powered by a battery with an emf of 1 V and negligible internal resistance. Estimate the current through the 10 Ω and 20 Ω resistance (20 Marks)

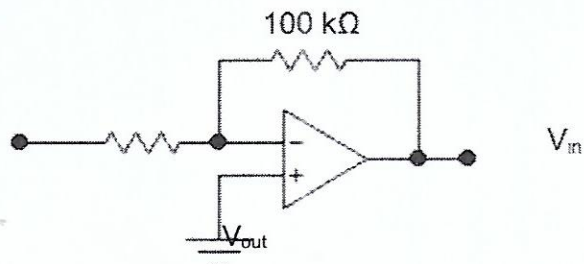


8.2 The following circuit consist of a silicon transistor with a β value of 50. Estimate the V_{CE} and the collector current I_C in the circuit given in the following figure (You may assume that the transistor is active and $V_{CC} = 10$ V) (30 Marks)



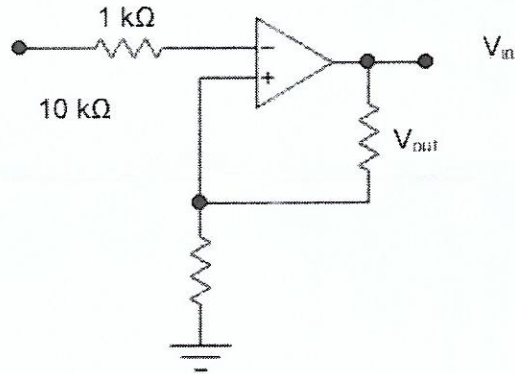
8.3 Estimate V_{out} in the following circuits 8.3.1 and 8.3.2 if V_{in} is given as 20 mV.

8.3.1



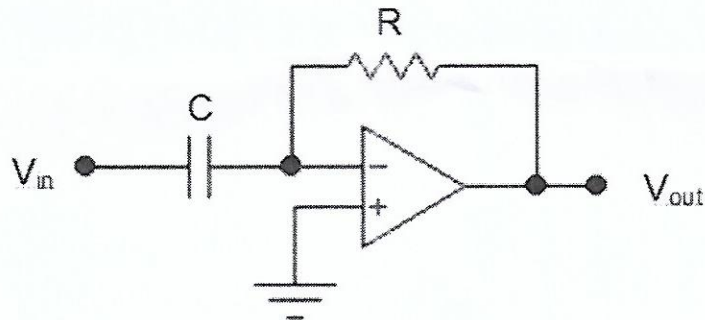
(15 Marks)

8.3.2



(15 Marks)

8.4 Derive an expression for V_{out} of the following circuit in terms of V_{in} , C and R



(20 Marks)

Hint: Current (I) through a capacitor can be written as $I = c \frac{dV}{dt}$, where c is the capacitance, V is the voltage difference across the resistance and t is time.