UNIVERSITY OF JAFFNA, SRI LANKA

BACHELOR OF SCIENCE IN MEDICAL LABORATORY SCIENCES

SECOND YEAR FIRST SEMESTER EXAMINATION – OCTOBER 2019

MLSMT 2144 MEDICAL LABORATORY TECHNOLOGY I

Date: 05.11.2019 **Time: 3 Hours**

ANSWER ALL EIGHT QUESTIONS.
ANSWER PARTS A, B AND C IN SEPARATE ANSWER BOOKS.

PART A

1.

1.1 What is meant by radioactivity? (10 Marks)

1.2 Give two differences between beta minus and gamma radiation. (15 Marks)

1.3 Give the importance of biological half-life time of a radionuclide in nuclear medicine. (15 Marks)

1.4 Give the relationship between physical decay constant and biological decay constant of a radionuclide and obtain the relationship between their half-life's. Estimate the effective half-life time of I-131. (The half-life timeof I-131 is 8 days and biological half-life time of I-131 in thyroid gland is 24 days) (30 Marks)

1.5 A 100 mCi of small radio I-131 sample is administered to a patient to treat the thyroid cancer. Estimate the activity of I-131 sample in a patient after 4 days of administration. (20 Marks)

1.6 Explain briefly why I-131 capsule is kept in the lead container. (10 Marks)

2.

2.1 Why treatment simulation used in radiation treatment planning? (15 Marks)

2.2 Briefly explain why poor quality port films are obtained in treatment machines. (30 Marks)

2.3 Give the uses of wedge filter in radiotherapy. Describe how wedge filters change the isodose lines when they are used during the radiation treatment. (30 Marks)

2.4 Give the advantages of multiple coplanar beams used in teletheraphy machines. (25 Marks)

3.

3.1 Briefly explain the harmful effects of ionizing radiation on human tissue. (45 Marks)

3.2 Define radiation absorbed dose. A 50.0kg female patient is absorbs 1.00 J of gamma radiation during her treatment. Estimate the absorbed dose in this patient. (25 Marks)

3.3 Distinguish between deterministic and stochastic effect in radiation protection. (30 Marks)

4.

4.1 Briefly describe the following events in X-ray production.

4.1.1 Energetic electron interacts with outer shell electron of the target atom. (15 Marks)

4.1.2 Energetic electron approaches the nucleus of the target atom. (15 Marks)

4.1.3 Energetic electron interacts with inner shell electron of the target atom. (15 Marks)

4.2 Briefly describe the line focusing principle in X-ray production. (25 Marks)

4.3Briefly explain why intensities of X-ray beam vary across the anode during X-ray production. (30 Marks)

5.

5.1 Briefly describe the working principle of medical cyclotron with a suitable labelled diagram. (30 Marks)

5.2 Give the functions of each component in gamma camera

5.2.1 Collimator (10 Marks)

5.2.2 NaI crystal (10 Marks)

5.2.3 Photo Multiplier Tube (10 Marks)

5.3 Briefly describe the radioimmunoassay technique and its advantages. (40 Marks)

PART B

6.

6.1 What are the four important characteristics that differentiate laser beam from ordinary light? (10Marks)

6.2 Briefly explain how a light beam interacts with an active medium when it transverses through it? (10 Marks)

6.3 What is meant by population inversion? (20 Marks)

6.4 How population inversion is achieved within an active? (10Marks)

6.5 Describe the photodynamic therapy (PDT) used for treating tumour? (20 Marks)

6.6 Explain how different amount of heat energy of a laser used in medical applications? (10 Marks)

7.

7.1Give main types of imaging modalities? (25 Marks)

7.2 Briefly describe the main functions of the cathode, anode and housing of an X-ray tube. (15Marks)

7.3 Why tungsten is a good choice for both the filament and the target material? (20 Marks)

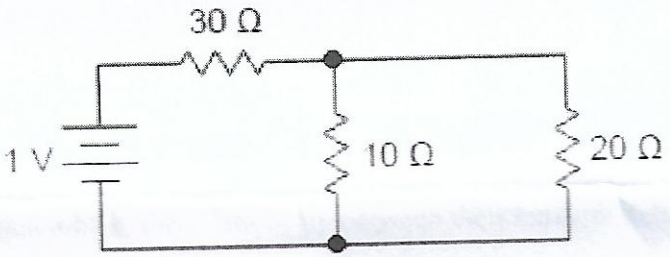
7.4How intensity of the X-ray ~~output~~ produced within an X-ray tube can be adjusted? (20 Marks)

7.5What does the kV setting on a console control? (20 Marks)

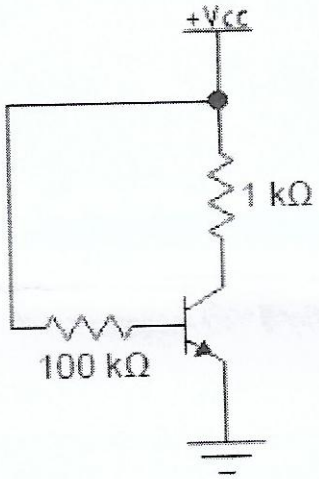
PART C

8.

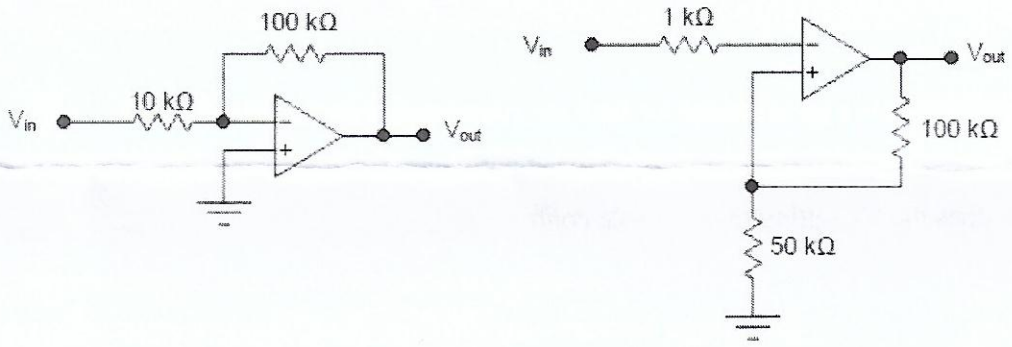
8.1 The following circuit is powered by a battery with an emf of 1 V and negligible internal resistance. Estimate the current through the 10 Ω and 20 Ω resistances. (20 Marks)



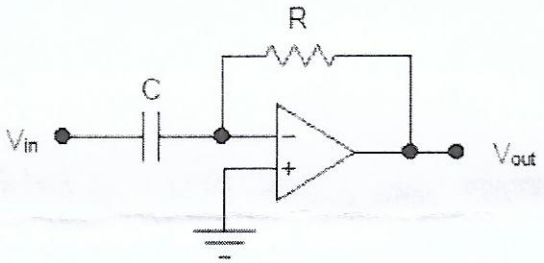
8.2. The following circuit consists of a Silicon transistor with a β value of 50. Estimate the V_{CE} and the collector current (I_C) in the circuit given in the following figure (You may assume that the transistor is active and Vcc = 10 V, at active region, $I_C = \beta I_B$) (30 Marks)



8.3Estimate V_{out} in the following circuits if V_{in} is given as 20 mV. (30 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.