

UNIVERSITY OF JAFFNA, SRI LANKA
BACHELOR OF SCIENCE IN MEDICAL LABORATORY SCIENCES
SECOND YEAR FIRST SEMSTER EXAMINATION – AUGUST 2016

MLSMT 2144 MEDICAL LABORATORY TECHNOLOGY I

Date: 18.08.2016

Time: 3 hours

ANSWER ALL EIGHT QUESTIONS.

ANSWER PARTS A AND B IN SEPARATE ANSWER BOOKS

PART A

1.

- 1.1 Briefly explain the principle of X-ray generation. (10 Marks)
- 1.2 Briefly describe the mechanism by where heat is produced in a X-ray tube. (15 Marks)
- 1.3 Explain how heat production in a X-ray tube can be minimized? (15 Marks)
- 1.4 Briefly explain the features of anode in a X-ray tube. (30 Marks)
- 1.5 Briefly discuss how quality and quantity of a X-ray beam in a X-ray machine are controlled by a Radiographer? (30 Marks)

2.

- 2.1 Draw a labeled diagram of a telecobalt-60 machine. (25 Marks)
- 2.2 List the features of a Co-60 radiation source. (25 Marks)
- 2.3 List the properties of collimators used in a telecobalt-60 machine. (25 Marks)
- 2.4 Distinguish between external beam radiotherapy and brachytherapy. (10 Marks)
- 2.5 Briefly describe the importance of immobilization device in an external beam radiotherapy. (15 Marks)

3.

- 3.1 Write short notes on
- 3.1.1 Generations of linear accelerator (40 Marks)
- 3.1.2 Uses of wedge filters in radiation treatment (60 Marks)

4.

4.1 Briefly discuss the imaging principle of a gamma camera. (45 Marks)

4.2 Briefly describe the different detection event of a gamma camera imaging on the followings.

4.2.1 Valid event (15 Marks)

4.2.2 Detector scatter event (15 Marks)

4.2.3 Object scatter event (15 Marks)

4.2.4 Spatial penetration (10 Marks)

5.

5.1 Distinguish between direct and indirect actions of ionizing radiation in a target with suitable examples. (30 Marks)

5.2 Briefly describe the principles used in radiation protection. (20 Marks)

5.3 Briefly describe the principle of radionuclide production by using cyclotron. (50 Marks)

PART B

6. Lasers are finding many applications in medicine and biology. While most laser use focuses on the heat generation of the laser beam interacting with tissue, spectroscopic aspects play a major dominating part in number of emerging applications. Tumour-seeking agents, such as hematoporphyrin derivative (HPD), in combination with laser radiation provide new possibilities for cancer tumour detection and treatment.

Source: S Svanberg, Medical Applications of Laser Spectroscopy, Physica Scripta, Volume 1989, T26

6.1 What are the special features of a laser beam? (10 Marks)

6.2 What are the three processes occurs in active medium when the light transverses through it? (10 Marks)

6.3 What is meant by population inversion? (10 Marks)

6.4 What are the processes occur during interaction of laser beam with human tissue? (10 Marks)

6.5 What are the measurements that can be ascertained with a diagnostic laser? (10 Marks)

6.6 Briefly explain the photodynamic therapy (PDT) used for treating tumour? (20 Marks)

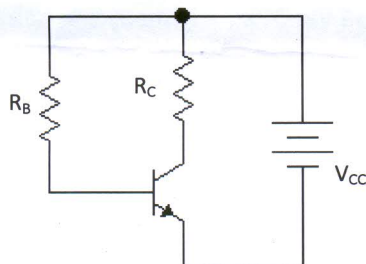
6.7 Explain the application of different amount of heat energy of a laser used in medical applications? (30 Marks)

7. 7.1 State the two types of bipolar junction transistor and draw their circuit symbols by naming the terminals. (20 Marks)

7.2 Sketch the family of transfer characteristic curves of an *npn* bipolar junction transistor. (30 Marks)

7.3 Write down the relationship between collector current I_C and base current I_B of an *npn* bipolar junction transistor which operates in active region. (10 Marks)

7.4 A silicon transistor having $\beta = 80$ is biased as shown in the following figure. where $V_{CE} = 8V$, $R_C = 3k\Omega$, and $V_{CC} = 15V$.



7.4.1 Estimate the collector current I_C , base current I_B and base resistor R_B . (30 Marks)

7.4.2 If the transistor is replaced with a germanium transistor, estimate the new collector current I_C , base current I_B and base resistor R_B . (10 Marks)

You may find the information useful.

$V_{BE} = 0.7V$ for Si transistor and $V_{BE} = 0.3V$ for Ge transistor)

Notations have their usual meaning.

8. 8.1 Briefly explain the formation of n -type and p-type semiconductor. (20 Marks)

8.2 Explain the formation of depletion region at the p-n junction. (10 Marks)

8.3 Sketch the waveforms of a half-wave rectifier with and without a smoothing capacitor across the load resistor R_L . (20 Marks)

8.4 Draw the circuit symbols and write down the corresponding truth tables of the following digital gates: (30 Marks)

8.4.1. AND

8.4.2 NAND

8.4.3 OR

8.4.4. NOR

8.4.5 XOR

8.4.6 XNOR

8.5 Define the Boolean functions in terms of given variables at points *a* and *b* (20 Marks)

