

UNIVERSITY OF JAFFNA, SRI LANKA
BACHELOR OF SCIENCE IN MEDICAL LABORATORY SCIENCES
SECOND YEAR FIRST SEMESTER EXAMINATION-JULY 2013

MLSMT 2104 MEDICAL LABORATORY TECHNOLOGY-I

Date: 23.08.2013

Time: 3 Hours

ANSWER ALL EIGHT QUESTIONS

ANSWER EACH PART IN SEPARATE ANSWER BOOK

PART A

1.

- 1.1.** What is meant by specific activity of a radionuclide? (10 Marks)
- 1.2.** List the features of Co-60, a radionuclide in teletherapy machines. (20 Marks)
- 1.3.** Calculate the activity of 1 g of pure Co-60. (30 Marks)
- 1.4.** Calculate the specific activity of Co-60. (20 Marks)
- 1.5.** Give reason why the practical value of the specific activity of a radionuclide differs from the theoretical value. (20 Marks)

2.

- 2.1.** List the safe radiation work practices used in nuclear medicine laboratory. (30 Marks)
- 2.2.** List the features of tungsten metal used in X-ray tube as cathode filament. (25 Marks)
- 2.3.** Calculate the required thickness to reduce the radiation beam intensity to 20 % from the original beam (Unattenuated beam).

(The half value layer of a monochromatic beam in a material is 3 cm.) (45Marks)

3.

3.1. Briefly describe the function of free air ionization chamber in measurement of ionizing radiation. (30 Marks)

3.2. Define the following terms in radiation.

3.2.1 Exposure (15 Marks)

3.2.2 Absorbed dose (15 Marks)

3.3 Convert the exposure of 1 Roentgen in absorbed dose. (40 Marks)

(You may use the following informations: The charge of an ion is 1.6×10^{-19} Coulomb, $eV = 1.6 \times 10^{-19}$ Joules, The conversion factor is the $W = 33.97$ eV/ion pair).

4.

4.1List the names of radiation safety devices used for the patients during the radiotherapy. (40 Marks)

4.2 Explain direct action and indirect action in biological effect of ionizing radiation and give two examples for each. (30 Marks)

4.3 Briefly describe the features of Tc-99m radionuclide. (30 Marks)

PART B

5. Safe use of radiation is practiced in the screening, diagnosis and treatment of cancer incorporating many technological advances.

5.1. List the uses of radiation for screening and diagnosis of cancer. (10 Marks)

5.2. Describe how does the radiation kill the cancer cells? (15 Marks)

5.3. Mention factors that affect radiation sensitivity under following headings...

5.3.1. Physical factors. (05 Marks)

5.3.2. Chemical factors (05 Marks)

5.3.3. Biological factors (05 Marks)

5.4. Why does the radiation given in many fractions than a single fraction? (20 Marks)

5.5. Describe 5 types of fractionations that we usually practice in the cancer treatment.

(10 Marks)

5.6. Describe Biological effects due to the exposure to Ionizing Radiation (10 Marks)

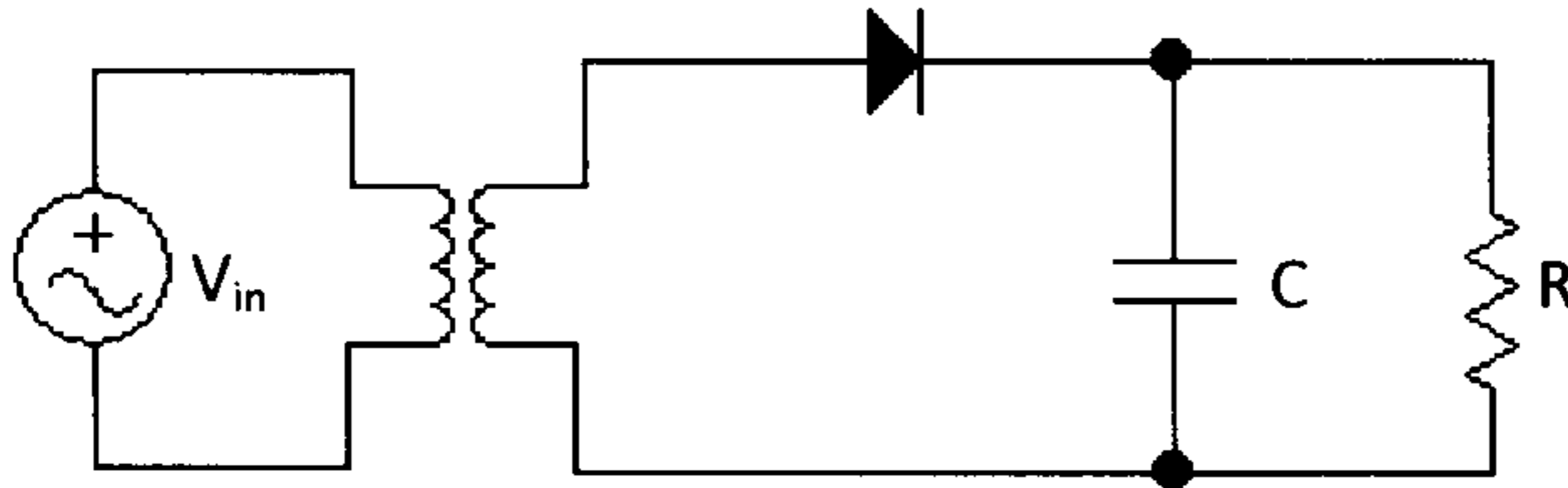
5.7. Discuss radiation protection principles to prevent radiation hazard to human. (15 Marks)

5.8. Draw a sketch of a bunker to house Cobalt 60 Radiotherapy machine. (05 Marks)

PART C

6.

(a). Following circuit is a half wave rectifier with a single p-n junction diode. The V_{in} is a sine wave generator with the frequency of 50 Hz.



Sketch the out put waveforms across resistor R, **with and without** capacitor C.

[15+15=30 Marks]

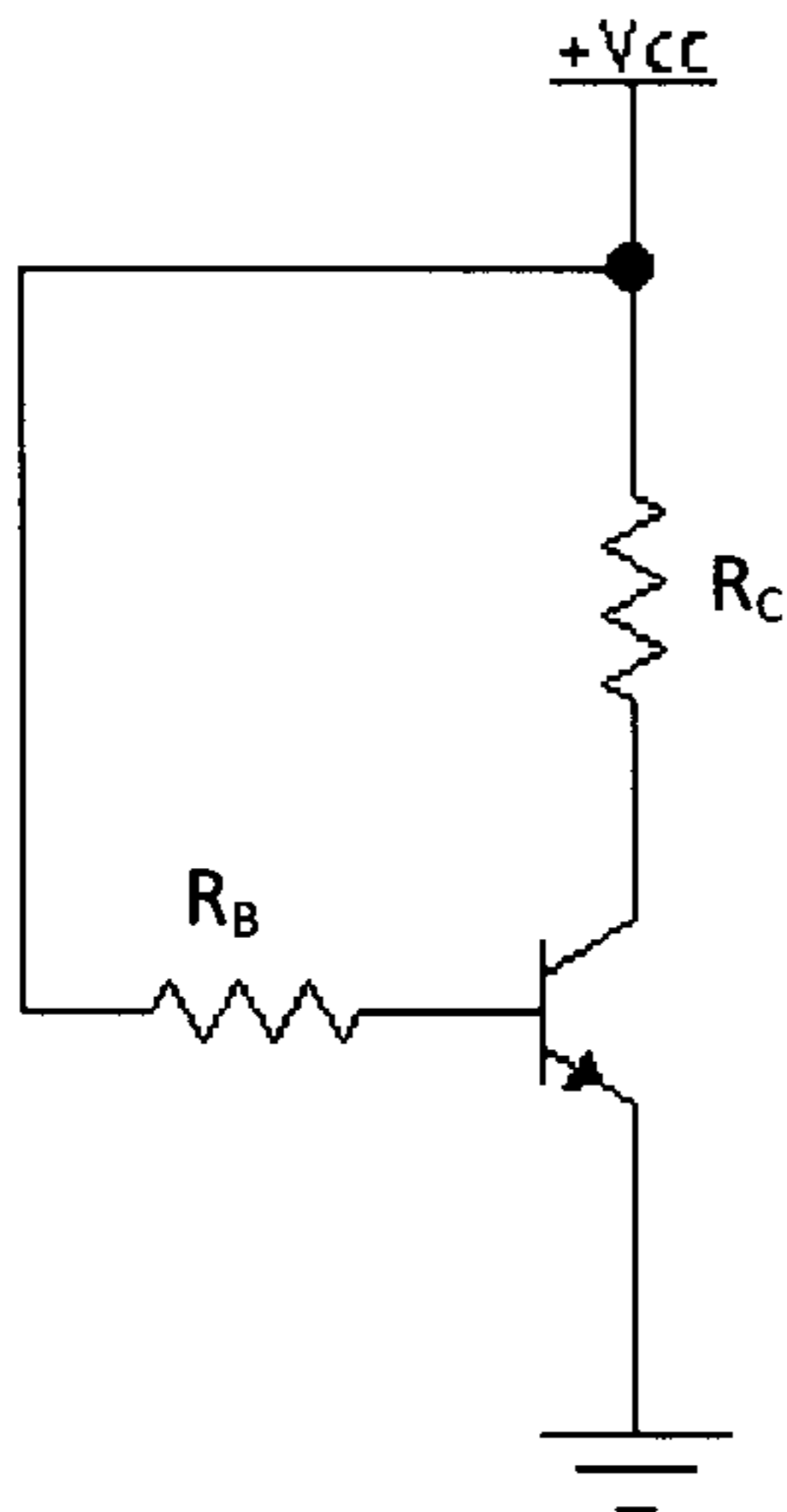
(b). Following circuit consist a Silicon transistor which has $\beta=100$. the values of $V_{CC}=10$ V, $R_C=1.5$ K Ω , $R_B=500$ K Ω .

i. Calculate the collector current I_C [20 Marks]

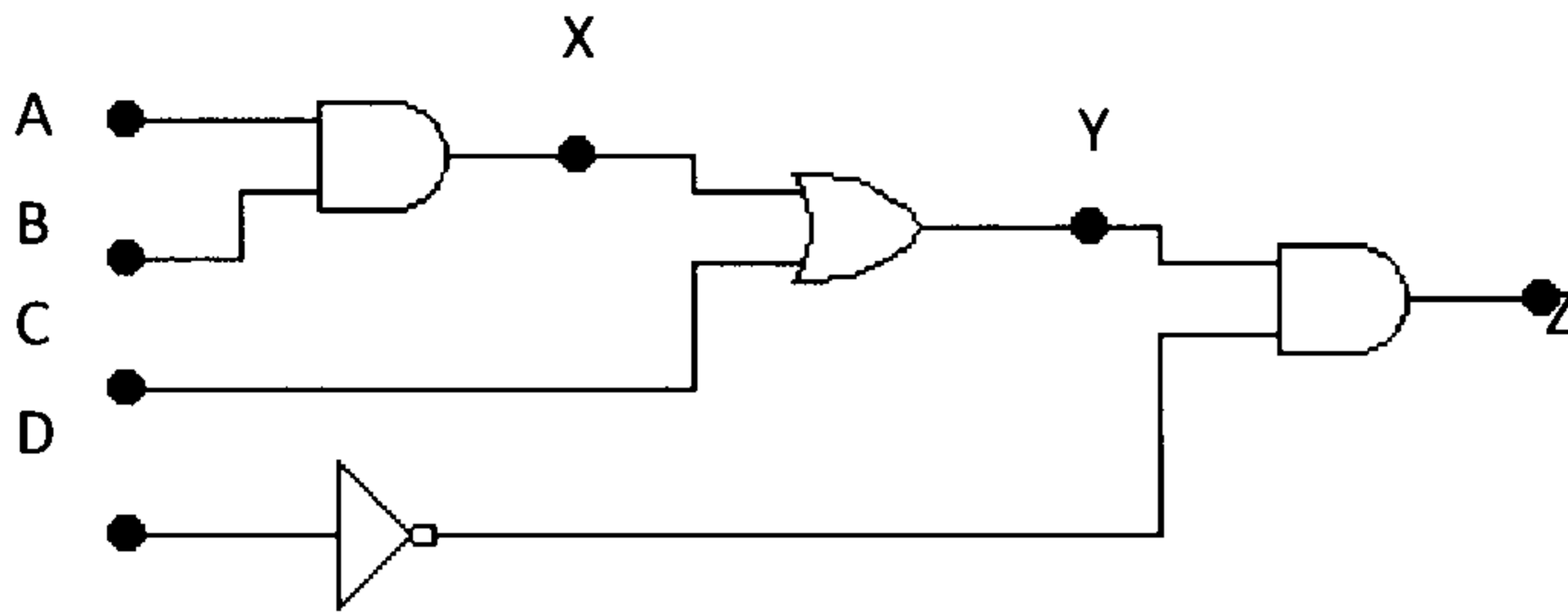
ii. calculate the voltage across emitter and collector terminal V_{CE} .

[20 Marks]

[Hint: for silicon transistors, in active region $V_{BE}=0.7$ V]



(c). Write down the boolean functions at points X, Y and Z.



[10+10+10=30 Marks]

7.

(a) According to which principle the light rays are travelling through the optical fiber?

[10 Marks]

(b) Write down the law of refraction when a light ray incident on the medium of refractive index n_1 from a medium of refractive index n_2 .

[20 Marks]

(c) Write down the properties of LASER.

[20 Marks]

(d) Write down the common type of medical lasers and their major indications for the treatment of Dentistry, Gastroenterology, and Cardio vascular problems.

[15 Marks]

(e) A Nd:YAG laser operates in pulsed mode, with an energy of 100 mJ per pulse, and pulse repetition rate of 10Hz (i.e., 10 pulses per second). Each pulse lasts for 1 ns, and in between pulses, no light is emitted.

i). What is the instantaneous laser power during each pulse?

[20 Marks]

ii). What is the average power output of this LASER.

[15 Marks]

8.

(a) Write down the relationship between inter-planer spacing between two parallel planes for a cubic crystal and Miller indices (hkl).

[20 Marks]

(b) A beam of X ray is sent into the sample and the diffracted beam is studied. The diffracted beam constructively interfere each other. Write down the condition for constructive interference.

[20 Marks]

(c) Write down any four applications of X ray diffraction.

[20 Marks]

(d) Explain the determination of calcification in bioprosthetic cardiac valve using X ray diffraction method.

[20 Marks]

- (e) The edge of a unit cell in a cubic crystal is 2.62 \AA . Find the Bragg angles corresponding to the reflection from the plane (011), given that the monochromatic X ray beam has a wavelength is 1.54 \AA . [20 Marks]

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