UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	FUNDAMENTAL OF HEALTH PHYSICS
COURSE CODE	:	DAU 24102
PROGRAMME CODE	:	DAU
EXAMINATION DATE	:	JUNE 2017
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	SECTION A: ANSWER **ALL** QUESTIONS SECTION B: ANSWER **TWO (2)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

SECTION A

Q1 (a) Name **TWO (2)** Regulatory Bodies at International or National level which lay down norms for radiation protection.

(2 marks)

(b) State effective dose and equivalent dose specified by International Commission for Radiation Protection (ICRP) and the National Commission for Radiation Protection (NCRP) for radiation worker.

(4 marks)

(c) In order to reduce doses from intake of radioactive substances, the following basic time, distance and shielding need to be considered. If a radiation worker has a dose limit to 100 mrem. Calculate:

(i) The duration of radiation worker can stay in a 1.5 mrem/hr in radiation field.

(3 marks)

(ii) The exposure rate at 1 meter from the source if exposure rate at 0.3 m from source is 500 mR/hr.

(3 marks)

(d) Give **FOUR (4)** aspects of shielding in diagnostic radiology.

(4 marks)

(e) Any practice resulting in exposure to radiation should be carefully planned in accordance with the three basic radiological protective principles. Explain briefly these basic principles.

(9 marks)

Q2 (a) (i) Describe the functions of radiation detection devices.

(5 marks)

(ii) List **THREE (3)** types of radiation detection devices.

(3 marks)

(b) Personnel dosimeters is a monitoring device worn by a person entering environments that may contain radiation.

(i) State **ONE (1)** type of personal dosimeter.

(1 mark)

(ii) From your answer in **Q2 (b)(i)**, give **THREE (3)** advantages and disadvantages of that dosimeter.

(6 marks)

(c) Analyse the situation when a spillage of liquid radioactive material in the laboratory in order to control the potential hazard and clean up the area.

(10 marks)

SECTION B

Q3 (a) State **THREE (3)** types of radiation.

(3 marks)

(b) From you answer on **Q3 (a)**, give **THREE (3)** differences on these radiation.

(9 marks)

(c) The rate decay for isotope is proportional to the number of nuclides present. Show that the rate of decay or activity, A can be given as $A = A_o e^{-\lambda t}$, where A_o is initial activity and t is time.

(6 marks)

(d) The isotope ^{135}Cs is a standard laboratory source of gamma rays. The half-life of ^{135}Cs is 30 years.

(i) Convert the ^{135}Cs atoms in a 5.0 μCi source to its SI unit.

(2 marks)

(ii) Compute the activity of the source 10 years later.

(5 marks)

Q4 (a) A Polonium, $^{210}_{84}Po$ decays via alpha decays and form Pb as a daughter nuclide.

(i) Write the nuclear reaction equation.

(2 marks)

(ii) Express that both nucleon number and atomic number are conserved in the reaction.

(4 marks)

(b) An incoming x-ray photon of wavelength 10.0 pm are incident on a target. Calculate the wavelength of the x-ray when it scattered at 110°.

(8 marks)

(c) Several types of interactions with matter have been observed when photon travels and hits either an electron or nucleus. Explain briefly the interaction of the following:

(i) Bremsstrahlung.

(ii) Rayleigh scattering.

(iii) Auger electrons.

(iv) Neutron interaction.

(11 marks)

Q5 (a) Define the followings :

(i) Committed equivalent dose.

(ii) Committed effective dose.

(4 marks)

(b) We are exposed to radiation every day and become hazards to our lives. Describe internal hazard and external hazard.

(8 marks)

(c) Differentiate stochastic and non-stochastic effects.

(8 marks)

(d) A 65 kg worker is accidentally exposed to gamma radiation and receives an affective dose 5.5 rem. Calculate the absorbed dose received by the worker in Gray (Gy). (Given: weighting factor, W_T : 0.12, Quality factor, Q :1).

(5 marks)

-END OF QUESTIONS –

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LIST OF FORMULA

$D = \frac{A_0}{\sqrt{2}} t_1$	$\frac{dN}{dt} = -\lambda N$
$E = \frac{hc}{\lambda}$	$V = \frac{Q}{C}$
$A = \frac{dN}{dt}$	$ln \frac{N}{N_0} = kt$
$k = \frac{ln2}{T_{1/2}}$	$\frac{l_1}{l_2} = \frac{{d_1}^2}{{d_2}^2}$
$A = A_0 e^{-\lambda t}$	$T_{1/2} = \frac{ln2}{\lambda}$
$N = N_0 e^{-\lambda t}$	$X = \frac{dQ}{dm}$
$N = \frac{\frac{-dN}{dt}}{\lambda}$	$D = \frac{E}{m}$
$D = D_0 e^{-\mu x}$	$D_W = D_G$
$H(Sv) = D(Gy)Weight$ $H_T(Sv) = \sum_R W_R D$ $E(Sv) = \sum_T W_T H$ $H = H_1 + H_2$	$D_W = \frac{N_g E}{m}$

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LIST OF CONSTANT

$$\text{Avogadro's Number, } N_A = 6.023 \times 10^{23} \text{ atoms}$$
$$\text{Electron charge, } e = 1.6 \times 10^{19} \text{C}$$
$$\text{Electron mass, } m_e = 9.109 \times 10^{-31} \text{kg}$$
$$\text{Neutron mass, } m_n = 1.675 \times 10^{-27} \text{kg}$$
$$\text{Proton mass, } m_p = 1.673 \times 10^{-27} \text{kg}$$
$$\text{Atomic mass number, } u = 1.6605 \times 10^{-27} \text{kg}$$
$$= 931.5 \text{MeV}$$
$$\text{Plank's Constant, } h = 6.626 \times 10^{-34} \text{J}$$
$$\text{Speed of light, } c = 3 \times 10^{8} \text{ms}^{-1}$$
$$1 \text{ Curie (Ci)} = 3.7 \times 10^{10} \text{Becquerel (Bq)}$$
$$1 \text{ Rad (Rad)} = 10^{-2} \text{ Grays (Gy)}$$
$$1 \text{ Rem(rem)} = 10^{-2} \text{Sieverts (Sv)}$$
$$1 \text{ Roentgen (R)} = 2.58 \times 10^{-4} \frac{\text{Coulomb}}{\text{kilogram}} \left(\frac{\text{C}}{\text{kg}}\right)$$
$$1 \text{ Gy} = 100 \text{ rad} = 1 \text{Jkg}^{-1}$$
$$1 \text{ R} = 8.77 \times 10^{3} \text{Grays (Gy)}$$

Absorbed Dose, D

Equivalent Dose, H

Effective Dose, E

Exposure, X

Radiation, R

Tissue, T

Charge, Q

Number of ionized, N_g

Dose to the wall, D_w = dose to the gas, D_G