Assiut University		Program: Diploma
Faculty of Science		Date: 15/9/2015
Physics Department		Time Allowed: 3 hours

Course Title: Sources and radiological protection - Code: P534 - Final Exam

Solve the following problems? (100 Marks)

$A_o = 6.02\times10^{23}$ atoms/mol, μ_{air} (STP) $= 3.46\times10^{-5}$ cm^{-1}, $\rho_{air} = 1.293$ kg/m^3

1) Deduce the transformation constant and half-life of ^{226}Ra if the radon gas in secular equilibrium with 1 g Ra exerts a partial pressure of 4.8×10^{-4} mm Hg in a 1-L flask and if the half-life of radon is 3.8 days.

Ans: (10 Marks)

2) Calculate the specific activities of ^{14}C and ^{35}S, given that their half-lives are 5730 yr and 87 days, respectively.

Ans: (5 Marks)

3) If 2 g of carbon from a piece of wood found in an ancient temple is analyzed and found to have an activity of 10 transformations/ minute/gram, what is the age of the wood if the current specific activity of 14C (5730 yr) in carbon is assumed to have been constant at 15 transformations/minute/gram?

Ans: (5 Marks)

4) A very small source (physically) 1.0 Ci of ^{32}P ($E_{\beta max} = 1.71$ MeV) is inside a lead shield just thick enough to prevent any beta particles from emerging. What is the bremsstrahlung energy flux at a distance of 10 cm from the source (neglect attenuation of the bremsstrahlung by the beta shield)?

Ans: (10 Marks)

5) Aluminum bronze, an alloy containing 90% Cu (atomic weight = 63.57) and 10% Al (atomic weight = 26.98) by weight, has a density of 7.6 g/cm^3. What are the linear and mass attenuation coefficients for 0.4 MeV gamma rays if the cross sections for Cu and Al for this quantum energy are 9.91 and 4.45 b?

Ans: (10 Marks)

6) A worker accidentally spills 3700 Bq (10 μCi) of a ^{32}P solution over an area of 10 cm^2 on her skin. What is the dose rate to the contaminated skin? Where, For ^{32}P: E_{max} = 1.71 MeV and E_{mean} = 0.7 MeV.

Ans: (5 Marks)

7) Calculate the dose rate to the skin of a person immersed in a large cloud of ^{85}Kr at a concentration of 37 kBq/m^3 (10^{-6} μCi/mL). Where ^{85}Kr is a pure beta emitter that is transformed to ^{85}Rb by the emission of a beta particle whose maximum energy is 0.672 MeV and whose average energy is 0.246 MeV.

Ans:

(5 Marks)

8) Consider two radiation fields of equal energy flux. In one case, we have a 0.1-MeV photon flux of 2000 photons/cm^2/s. In the second case, the photon energy is 2 MeV and the flux is 100 photons/cm^2/s. Calculate the dose rates for the two radiation fields. Where the energy absorption coefficients for muscle are μ (0.1 MeV) = 0.0252 cm^2/g and μ (2.0 MeV) = 0.0257 cm^2/g.

Ans:

(5 Marks)

9) A 10-Ci ^{60}Co source failed to be retracted into its shield. The operator walks toward the source at a rate of 1 m/s, and, at a distance of 1 m from the source, he stops, looks at the exposed source for 15 s, realizes that the source is not in the shield, and leaves at a rate of 2 m/s. What is his dose commitment from this exposure?

Ans: (15 Marks)

10) A survey meter, whose time constant is 4 seconds reads 10 mR (100 μ Sv) per hour while measuring the radiation from a dental X-ray exposure of 0.08 second.

a) What was the actual exposure rate?

b) What would have been the dose to the dental hygienist if she had been at the point of measurement?

Ans: (10 Marks)

11) A counting standard whose transformation rate is given as 1000 ± 30 min^{-1} is used to determine the efficiency of a counting system. The measured count rate is 200 ± 10 min^{-1}. What is the efficiency of the counting system and the precision of the measurement?

Ans: (10 Marks)

12) Define only five from the following:

a) Linear Energy Transfer
b) Synchrotron radiation
c) Specific activity
d) Kerma
e) The atomic attenuation coefficient
f) Absorbed dose

Ans:

(10 Marks)

Assiut University		Program: Diploma
Faculty of Science		Date: Sep. 17, 2015
Physics Department		Time Allowed: 3 hours
Course Title: Reactor Physics	Course Code: 535P	Final Exam (100 Marks)

A) Answer ALL the Following THREE Questions.

Question 1 **(40 Marks, 20 per each)**

a) There are many mechanisms of the neutron-nuclear interactions. Discuss four of them in terms of the interaction cross-section, neutron energy, and the mass number of the target nucleus.

b) Define the multiplication factor, k, discussing how it determines the degree of the nuclear criticality.

Question 2 **(30 Marks, 15 per each)**

a) A nuclear reactor has a complex construction. Describe, briefly, the basic elements of the nuclear reactor core.

b) Define the following five terms:

Reactor thermal power; Plant electrical power; Core power density; Fuel loading; and Fuel enrichment.

Question 3 **(30 Marks, 15 per each)**

a) "Control rods represent a negative reactivity". Discuss this sentence showing the role of these rods to control the power generated from the reactor.

b) Define the following four terms:

Excess reactivity; Shutdown margin; Control element worth; and Total control element worth.

End of the Exam.....Good Luck

Dr. Mohamed Omer

Faculty of Science

Assiut University

Postgraduate Exam.

Sep. 2015

Diploma in Physics

Biophysics (533 P)

Time allowed: 3 hours

Try on all of the following: **(Total Degree: 100 Marks)**

I- Write on:

A – Types of Radiation.

B – Radiation Energy.

C – Natural Radioactive Series.

D – Induced Radioactivity .

(10 Marks each)

II- Discuss fully:

A – The mechanism of radioactive decay and unit of radioactivity.

B – The interaction of radiation with the matter.

C – Absorption of energy (absorbed dose, equivalent dose, effective dose).

(20 Marks each)

Good luck.....

Faculty of science
Physics Department

Date: 8 December, 2015
Time: 3 hours

Written Examination for the Qualification of (Biophysics Diploma)
Nuclear Medicine Physics and Equipments (531P)]
Teaching Staff: Prof. Dr. Abdulaziz Abualfadl

Answer 5 questions from the following: [20 marks for each]

1- (a)- What is the difference between ordinary x-ray and nuclear medicine examinations?
(b)- An X-ray tube is operated at a peak voltage of 100 kV and the beam current is 40 mA. (i) What is the power of the machine? (ii) How many electrons reach the machine every second? (iii) How many photons are released every second?
(iv) What is the maximum energy of each photon? What is its wavelength?
[Data: $e = 1.6 \times 10^{-19}$ C; $h = 6.63 \times 10^{-34}$ Js; $c = 3 \times 10^{8}$ m/s]

2- (a)- Show how the intensifier screen and image intensifier tubes are used to reduce the exposure of a patient?
(b) How filters are most useful for shaping the x-ray beam to increase the number of photons that are best for imaging certain tissues and to reduce those that increase patient dose or decrease image contrast?

3-(a)- Write short notes on the characteristics of single photon emission computed tomography (SPECT) instrumentation?
(b)- Compare between CT and PET scanners and Why PET scanner can be combined with CT scanner into a single machine?

4-(a)- What are PET radioisotopes? And how radioisotope produced?
(b) Explain in brief radioisotope generator and specialized hospital-based cyclotrons?

5-(a)- Define the following:
i- Partial rings and panel geometry used in PET scanners iii- The non-collinearity of the gamma rays in PET scanners.

(b)- What are the benefits versus risks in nuclear medicine exam? What are the limitations of general nuclear medicine?

6- (a)- Show the main differences between SPECT and Anger camera scanners?
(b)-Write in brief on the function of collimator in gamma camera?

GOOD LUCK

Assiut University
Faculty of Science
Physics Department
Biophysics Diploma. Final Exam, Sep. 6, 2015
Course: Radiation doses measurement (530P)
Time: 3 hours
(Total mark= 100 Marks)

Answer the following questions:

Question 1

(25 marks)

Derive the following equation

$$N(t) = N(0)e^{-\lambda t}$$

Question2

(25 marks)

A Vial containing $^{99m}T_c$ is labeled 3mCi at 8 p.m. what is the activity at 8 a.m. on the same day? (DF (7 hr)=0.445).

Question 3

(25 marks)

Distinguish between different types of radiation detectors.

Question 4

(25 marks)

Explain the electronic instrumentation for radiation detection systems.

Good luck

Course coordinator: Dr. Hany Tawfik El-Gamal