Roll No: -------------------------

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: : MTech / Nuclear Science and Technology **Semester – I**
Subject (Course): Radiation Sources, Interaction, Detection and Measurement **Max. Marks : 100**
Course Code: NSAT 7003 **Duration : 3 Hrs**
No. of page/s: 2

Section- A

Answer all five questions, each question carries 4 marks

1. Describe the fluorescence x-rays and Auger electrons emission mechanisms
2. A proportional counter can be employed as a spectrometer but not a GM counter. Why?
3. List the fast neutron spectrometry techniques
4. Write the four components (modules) in a signal processing chain of a germanium detector
5. Describe briefly the two of those often used timing methods in radiation applications

Section- B

Answer all four questions, each question carries 10 marks

6. Explain the exact mechanism of scintillation in organic scintillators
7. Describe germanium detectors in planar and cylindrical configurations and write the expressions for their electrical field and capacitances in terms of bias voltage

   or

   A gamma-ray spectrometer records peaks corresponding to two different gamma-ray energies of 435 and 490 keV. What must be the energy resolution of the system (expressed as a percentage) in order just to distinguish these two peaks?
8. Explain the working principle of self-powered neutron detector and its main advantages and disadvantages in monitoring neutron flux in nuclear reactors
9. Describe the working of various components of multichannel analyzer in radiation energy spectrum analysis

Section- C

Answer both the questions, each question carries 20 marks

10. Give the classification of interaction of neutron with matter and explain each interaction mechanism

or

What is the transmission of 1 MeV photons through 10 cm of carbon, assuming only Compton scattering is dominant. The value of $\sigma_{Compton}$ = 2 x10^{-29} cm^2 per electron, ρ = 2000 $kg/m^{3.}$

11. Describe in detail the nuclear Instrumentation systems used for monitoring Boiling water reactors and pressurized water reactors

Roll No: --------------------------

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: : MTech / Nuclear Science and Technology | **Semester – I**
Subject (Course): Radiation Sources, Interaction, Detection and Measurement | **Max. Marks : 100**
Course Code: NSAT 7003 | **Duration : 3 Hrs**
No. of page/s: 2

Section- A

Answer all five questions, each question carries 4 marks

1. What is energy straggling in the case of interaction of light charged particles with matter?
2. Explain the role of Frisch grid in ionization detector
3. Explain forward and reverse biasing in the case of semiconductor detectors
4. Name any four converter materials and their reaction charged particle products employed in neutron detection
5. List any four types of detectors used for neutron monitoring of nuclear reactors

Section- B

Answer all four questions, each question carries 10 marks

6. Both the proportional counter and Geiger tube are based on internal gas multiplication. Comment on each separately and contrast their behavior with regard to : (a) Variation of pulse height with applied voltage (b) The need for a quench gas and its function (c) Ability to register high counting rates
7. Explain the mechanism of scintillation production in organic scintillators
8. Describe in detail fast neutron spectrometry method employing organic scintillators. How neutrons are discriminated against gamma rays in mixed neutron- gamma fields?

   or

   A material has a neutron cross section of 3.50 X 10^{-24} cm^2/ nuclei, and contains 4.20 x 10^{23} nuclei/ cm^3. Calculate the macroscopic cross section and the mean free path
9. Describe the Pressurized Heavy Water Reactor (PHWR) nuclear instrumentation

Section- C

Answer both the questions, each question carries 20 marks

10. Explain the definition of the depletion region in semiconductor detectors?. Explain why the depletion region is required for semiconductor detectors and what methods are employed to produce depletion

or

Calculate the mass attenuation coefficients of UO_2 for 1 MeV gamma rays. What is their mean free path? The density of UO_2 is about 10 g/ cm^3. The μ/ρ= 0.0757 cm^2/gm for uranium and 0.0636 cm^2/ gm for oxygen

11. Explain detail the functioning of preamplifier and amplifier in pulse or signal processing of a germanium detector