

**IV B.Tech I Semester Regular Examinations, November 2005****NUCLEAR METALLURGY**  
**(Metallurgy & Material Technology)****Time: 3 hours****Max Marks: 80****Answer any FIVE Questions**  
**All Questions carry equal marks**

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1. Explain the radioactive capture reactions in connection with the operation of Nuclear reactor for the following

(a) Capture of Neutrons by uranium  $^{238}_{92}\text{U}$

(b) Capture of Neutrons by Thorium  $^{232}_{90}\text{Th}$  [16]

2. Write a detailed account on the following

(a) thermal cycling

(b) protection against radiation.

(c) radiation detection. [5+6+5]

3. How are nuclear reactors classified on the basis neutron energies. Explain any 2 of them in detail. [16]

4. (a) What are the most promising sources for controlled nuclear fusion reactions? Give the reasons for the same.

(b) Show the potential fusion reactions of deuterium and tritium. [8+8]

5. (a) What is carnotite? Give the chemical formula of it. give the metallic elements present in the mineral.

(b) Explain the important physical and metallurgical characteristic properties of plutonium. [8+8]

6. (a) Briefly explain the refining process for thorium.

(b) Explain the advantages of using enriched uranium in a thermal reactor. [10+6]

7. Explain the extraction of Beryllium by fluoride process with a neat flow sheet. [16]

8. (a) What are the important properties of plutonium.

(b) Explain the recycling scheme for plutonium in a thermal reactor. [7+9]

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1. Discuss the status of Nuclear power programme in India. Mention locations, capacities and fuels used in different Nuclear power reactors of India. [16]
2. (a) what are the various sources from which radiation emanates and explain them fully.  
(b) Write a short notes on ‘ secondary gamma rays’  
(c) What is radiation attenuation? Explain radiation attenuation form a line source.  
[6+5+5]
3. What are the important elements of a nuclear reactor? Explain all of them in detail. [16]
4. (a) Describe how the fuel may be arranged in a thermal reactor.  
(b) What are the requirements of the fuel cladding utilized in a reactor? Explain them. [8+8]
5. (a) What are the primary minerals of uranium. Give their chemical formulae.  
(b) Explain the occurrence of minerals of uranium and write their general characteristics. [8+8]
6. (a) Explain why sulphide flotation process can't be employed for the extraction of uranium from its minerals.  
(b) Explain bacterial leaching with reference to the extraction of uranium.  
(c) Why dilute nitric acid leaching is preferred for thorium ores instead of sulphuric acid leaching. [6+5+5]
7. With the help of a flow sheet and necessary chemical reactions, Explain the production of nuclear grade zirconium. [16]
8. Name the various cost classifications involved, to find out the cost of production of electricity from generating stations. Explain them in detail. [16]

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1. (a) Compare and contrast between Nuclear fission and Nuclear fusion.  
(b) What is rate of radioactive decay? Derive the expression for decay constant.  
[8+8]
2. (a) Describe the early and delayed somatic effects of radiation.  
(b) Explain the genetic effects of radiation damage. [8+8]
3. How are nuclear reactors classified on the basis of construction of the core. Explain them fully. [16]
4. Discuss about the following types of control rods.  
(a) shim rods.  
(b) Fine control rods  
(c) safety rods. [6+5+5]
5. (a) What are the primary minerals of uranium. Give their chemical formulae.  
(b) Explain the occurrence of minerals of uranium and write their general characteristics. [8+8]
6. (a) What is meant by enrichment of uranium? Explain.  
(b) Explain the following methods of uranium enrichment.  
i. gas centrifuge process  
ii. electromagnetic enrichment process. [4+6+6]
7. Write an essay on the measures taken to conserve uranium supplies. [16]
8. (a) What are the important properties of plutonium.  
(b) Explain the recycling scheme for plutonium in a thermal reactor. [7+9]

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1. (a) Explain the following
  - i. Activity
  - ii. Neutrino.
  - iii. Radio active Isotopes
- (b) The average adult human body contains 0.25kg of normal potassium , of which 0.012 is the radio active beta emitter potassium-40( half life  $1.310^9$  years). Calculate the rate of production of beta particle in the body from the decay of potassium -40. What is the activity? (Assume suitably any missing or standard data) [9+7]
2. (a) Explain the terms
  - i. transient equilibrium &
  - ii. secular equilibrium in radioactive equilibrium process.
- (b) One of the natural radioactive series begins with uranium-235 (half life:  $7.04 \times 10^8$  years) which emits an alpha particle to form thorium 231(half-life 25.5h), the latter being a beta emitter. Starting with uranium-235 from which the decay products have been removed by chemical separation, determine
  - i. the atomic ratio of thorium-231 to the initial uranium-235
  - ii. the ratio of the total activity (rate of particle emission) to the initial value after 50h.
  - iii. the atomic ratio of the two nuclide mentioned when radioactive equilibrium is attained. [7+9]
3. (a) Distinguish between homogeneous nuclear reactors and Heterogeneous nuclear reactors.
- (b) Draw a neat sketch of a simplified nuclear reactor vessel and explain the various parts in it. [10+6]
4. (a) How are control rods classified? Explain the mechanism, that takes place in the working of control rods.
- (b) Write a detailed note on the fabrication of fuel elements. [9+7]
5. (a) What are the important minerals of thorium. give their chemical formula and composition.
- (b) Explain the occurrence of minerals of thorium and write their general characteristics. [8+8]

6. What are the various methods available for the enrichment of uranium. Explain any one method in detail. [16]
7. With the help of a flow sheet and necessary chemical reactions, Explain the production of nuclear grade zirconium. [16]
8. (a) What are the important properties of plutonium.  
(b) Explain the recycling scheme for plutonium in a thermal reactor. [7+9]

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