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

UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: : MTech / Nuclear Science and Technology **Semester – III**
Subject (Course): Fast Breeder Reactor **Max. Marks : 100**
Course Code: NSAT 8002 **Duration : 3 Hrs**
No. of page/s: 2

Section- A

Answer all five questions, each question carries 4 marks

1. What are the main differences between fissile and fertile isotopes? Name two examples for each
2. Give the complete breeding reactions for ^{238}U and ^{232}Th
3. Write the advantages and risks of sodium as a liquid coolant
4. List the Important engineered safety features of sodium cooled fast reactors
5. List the multiple barriers for defence-in-depth concept of sodium cooled fast reactor safety

Section- B

Answer all four questions, each question carries 10 marks

6. What are the desirable properties of reactor fuels?. List the prime candidates of fast breeder reactor fuel and their properties, advantages and disadvantages

or

A reactor is fuelled with 1500 kg of uranium rods enriched to 20 w/o in ^{235}U. The remainder is ^{238}U. The density of uranium is 19.1 gm/ cm3. What are the atom densities of ^{235}U and ^{238}U in the rods?. The atomic weights of ^{235}U and ^{238}U are 235.0459 and 238.0508 respectively

7. Define and write down the expressions of reactor, system, and compound doubling times of fast breeder reactors
8. List the prime candidates of fast breeder reactor clad and wrapper materials. What are the desirable properties of fast reactor structural materials?.
9. Describe the inherent safety features of sodium cooled fast reactors

Section- C

Answer both the questions, each question carries 20 marks

10. Explain in detail Doppler broadening and why does it occur and its effect on reactivity of a reactor

Or

In a critical reactor fuelled with natural uranium, it is observed that, for every neutron absorbed in ^{235}U, 0.254 neutrons are absorbed in resonances of ^{238}U and 0.640 neutrons are absorbed by ^{238}U at thermal energies. There is essentially no leakage of neutrons from the reactor. What is the conversion ratio of the reactor?

11. Explain the sources of radiation in a fast reactor and fast reactor shielding problems

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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: : MTech / Nuclear Science and Technology | **Semester – I**
Subject (Course): Fast Breeder Reactor | **Max. Marks : 100**
Course Code: NSAT 8002 | **Duration : 3 Hrs**
No. of page/s: 2

Section- A

Answer all five questions, each question carries 4 marks

1. Name the four most chemical forms of fast reactor fuels commonly used
2. Write the sodium reactions with water and air
3. What are the reasons for reactivity changes in a fast reactor?
4. List the Important inherent safety features of sodium cooled fast reactors
5. What are the materials used in fast reactor shielding?

Section- B

Answer all four questions, each question carries 10 marks

6. Give the criteria for selection of fast reactor coolants and compare the thermophysical properties of various potential fast reactor coolants
7. Define breeding ratio, breeding gain and condition for breeding. Give the complete breeding reactions for ^{238}U and ^{232}Th

   or

   The fuel for a reactor consists of pellets of uranium dioxide (UO_2), which have a density of 10.5 gm/ cm^3. If the uranium is enriched to 30 w/o in ^{235}U, what is the atom density of the ^{235}U in the fuel?
8. Describe and derive the corresponding equations of reactor doubling time, system doubling time, and compound system doubling times for fast breeder reactors
9. Explain the design solutions to prevent sodium leaks and fires in sodium cooled fast reactors

Section- C

Answer both the questions, each question carries 20 marks

10. Explain the concept of loop and pool type of fast reactors, and list their advantages and disadvantages

or

A hypothetical fast breeder reactor is fuelled with a mixture of ^{239}Pu and ^{238}U. When operating at full power, the plutonium is consumed at a rate of approximately 1 kg per day. The reactor contains 500 kg of ^{239}Pu at its initial start-up, and the breeding gain is 0.15. (a) At what rate is ^{239}Pu being produced? (b) Calculate the linear doubling time of this reactor.

11. Explain in detail the engineered safety features of Prototype Fast Breeder Reactor

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