



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND
TECHNOLOGY**

SCHOOL OF ENGINEERING AND TECHNOLOGY

**UNIVERSITY EXAMINATIONS FOR THE DEGREE IN SCIENCE IN
RENEWABLE ENERGY TECHNOLOGY AND MANAGENT**

3RD YEAR 2ND SEMESTER 2019/2020 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3323

COURSE TITLE: NUCLEAR ENERGY TECHNOLOGY

EXAM VENUE: STREAM: BSc REN TECH & MGT

DATE: 1/12//2020 EXAM SESSION:3-6 PM

DURATION: 2 HOURS

Instructions

1. Answer question 1 (Compulsory) and ANY other two questions

- 1. Candidates are advised to write on the text editor provided, or to write on a foolscap, scan and upload alongside the question.**
- 2. Candidates must ensure that they submit their work by clicking 'FINISH AND SUBMIT ATTEMPT' button at the end.**

Mass of a proton $m_p = 1.007277$ amu
Mass of a neutron $m_n = 1.008665$ amu
Mass of an electron $m_e = 0.000548597$ amu
 $1 \text{ amu} = 931.495 \text{ MeV}$ or $1.6606 \times 10^{-27} \text{ kg}$

QUESTION ONE (COMPULSORY)

- a) Define the following terms: (4 Marks)
- (i) Radioactivity
 - (ii) Radioactive decay constant
 - (iii) Mass defect
 - (iv) Fissile material
- b) Distinguish between chemical and nuclear reactions. (4 marks)
- c) Calculate the mass defect of Uranium-235 given that the mass of one uranium-235 atom is 235.043924 amu. Hence find the binding energy for the uranium-235 atom (5 Marks)
- d) Identify the missing particles in the following nuclear reactions. (6 Marks)
- (i) ${}^{238}_{92}\text{U} + \text{---} \rightarrow {}^{239}_{92}\text{U}$
 - (ii) ${}^{239}_{92}\text{U} \rightarrow {}^{239}_{94}\text{Pu} + \text{---}$
 - (iii) ${}^{235}_{92}\text{U} + {}^1_0\text{n} \rightarrow {}^{140}_{54}\text{Xe} + \text{---} + 2{}^1_0\text{n}$
- e) State the advantages of fast breeder reactors as oppose to other types of reactors. (5 Marks)
- f) Explain the purpose of a moderator in a chain reaction. List two different moderators commonly used in nuclear reactors. (2 Marks)
- g) Differentiate between enriched uranium and depleted uranium. (2 marks)
- h) Explain why uranium must be enriched before it can be used as fuel source in a nuclear reactor. (2marks)

QUESTION TWO

- a) A sample of material contains 20 micrograms of californium-252. Californium-252 has a half-life of 2.638 years. Calculate;
- (i) The number of californium-252 atoms initially present (2 Marks)
 - (ii) The activity of the californium-252 in curies. (3 Marks)
 - (iii) The number of californium-252 atoms that will remain after 12 years. (2 Marks)
 - (iv) The time it will take for the activity to reach 0.001 curies. (3 Marks)

- b) Briefly explain the stages involved in the Uranium – plutonium fuel cycle a Nuclear fuel Cycle. (10marks)

QUESTION THREE

- a) Describe the following nuclear processes. (4 Marks)
- (i) Thermonuclear fusion
 - (ii) Self-sustaining chain reaction
- b) With an aid of a neat diagram describe different components of a nuclear reactor. (6 Marks)
- c) Using a well-labelled flow diagram, explain the working of a CANDU type reactor. Give the merits and demerits of a CANDU type reactor over other reactor types. (10 Marks)

QUESTION FOUR

- a) In radioactive waste management the spent fuel may be taken through a processing plant. Other than making the uranium and plutonium available for recycling briefly discuss five merit for reprocessing. (5 Marks)
- b) List five kinds of external hazards to nuclear power plant. (5 Marks)
- c) Describe at least one lesson learned from each of the accidents at Chernobyl, Three Mile Island and Fukushima. (3 Marks)
- d) Describe five safety features built into a nuclear power plant. (5 Marks)
- e) Explain the term nuclear proliferation, hence explain why people should be concerned about uncontrolled nuclear proliferation. (2 Marks)

QUESTION FIVE

- a) Briefly discuss the various factors to be considered while selecting the site for nuclear power station. (5 marks)
- b) Outline various advantages of a nuclear power plant (5 Marks)
- c) Briefly discuss some of the factors which favours nuclear energy exploitation (5 Marks)
- d) Compare and contrast nuclear power plant with other steam power plants. (5 Marks)