



*(University of Choice)*

**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN CAMPUS**

**UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR**

**FIFTH YEAR SECOND SPECIAL/SUPPLEMENTARY**

**SEMESTER EXAMINATIONS**

**FOR THE DEGREE**

**OF**

**BACHELOR OF SCIENCE IN MECHANICAL AND  
INDUSTRIAL ENGINEERING**

**COURSE CODE: MIE 572**

**COURSE TITLE: RENEWABLE ENERGY RESOURCES**

**DATE: 6 – 10 - 2022**

**TIME: 3:00 PM – 5:00 PM**

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**INSTRUCTIONS TO CANDIDATES**

Answer Question ONE and any other TWO questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over

**Question 1**

**[30 marks]**

- (a) The position of the sun is specified by three angles: Name and explain the three angles  
[7 marks]
- (b) Describe three (3) stages in which the process of anaerobic digestion can take place during biogas digestion  
[9 marks]
- (c) Calculate the angle made by a beam radiation with the normal to a flat-plate collector on December 1 at 0900h (local apparent time). The collector is at a location (28° 35'N, 77° 12'E) and is tilted at an angle of 36° with the horizontal and is pointing due south.  
[7 marks]
- (d) The rating of a nuclear power plant for a submarine is 5 MW. Overall thermal efficiency is 30%. The fuel is U<sup>235</sup>. Find the amount of natural uranium needed to generate this power if the average energy release per fission for this fuel is 190 MeV.  
[7 marks]

**Question 2**

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- a) Calculate the average binding energy per nucleon for the following isotopes:
- i) <sup>92</sup>U<sup>235</sup> [6 marks]
  - ii) <sup>28</sup>Ni<sup>59</sup> [5 marks]
  - iii) Heavy hydrogen [5 marks]
- b) The surface treatment on the absorber plate is what actually performs the function of the conversion of the sun's radiant energy to thermal energy. The most commonly used surface treatments are black coatings. Give four (4) criteria a solar absorber coating must meet if it is to work well in practice  
[4 marks]

**Question 4**

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- a) Describe the following types of gasifiers in detail  
[9 marks]
- 1) up-draught or counter current
  - 2) down-draught or co-current
  - 3) Fluidised bed
- i. Conversion of an engine to a producer gas or dual-fuel operation will generally lead to a reduced power output. Explain the reasons for this  
[8 marks]

- ii. Based on temperature range classify biogas digestion [3 marks]

**Question 4**

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- (a) Describe the three (3) stages in the manufacturing process of charcoal briquetting [6 marks]
- (b) Concentrating solar collectors exhibit certain advantages and disadvantages as compared to conventional flat type. Give five (5) advantages and (3) disadvantages of the concentrating collectors. [8 marks]
- (c) Give four (4) limitations of geothermal energy resources [4 marks]
- (d) Give two (2) benefits of biogas digestion of wastes [2 marks]

