



THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

SECOND SEMESTER EXAMINATIONS – 2022

CEME 513- SUSTAINABLE TECHNOLOGY AND ENGINEERING

MSc in SOLID WASTE AND RESOURCES MANAGEMENT

MONDAY 24th OCTOBER 2022 – 10:00 AM

VENUE: PG CLASSROOM

TIME ALLOWED: 2 HOURS

INSTRUCTIONS FOR STUDENTS:

1. **WRITE YOUR NAME AND ID NUMBER CLEARLY ON THE FRONT PAGE OF THE ANSWER BOOKLET.**
2. You have 10 minutes to read this exam paper. You must not begin writing during this time.
3. All answers must be written in the answer booklet provided. No other written material is accepted.
4. Calculator only is allowed in the examination room. Notes and handouts are not allowed. MOBILE PHONE is not allowed.
5. Maximum Marks: 20.
6. Answer **ALL** questions. All questions carry equal marks.
7. Number of pages is 3 including Cover page and Appendices.

QUESTION 1 [(0.5+0.5)x5=5 marks]

Write in the answer booklet the accurate answer you choose. Present in the answer booklet concise and precise explanation(s) supporting the choice. Avoid use of alternative re-statement of questions as answers.

(a) A civil nuclear power plant is considered as an inappropriate technology for most countries

- i. True ii. False

(b) Biomass is a form of solar energy

- i. True ii. False

(c) In 2022, the per capita and total ecological footprints of the PNG are 1.82 and 14,800,000 global hectares, respectively. These number are very high.

- i. True ii. False

(d) It is impossible to implement participative justice to its fullest.

- i. True ii. False

(e) Currently, fossil fuels are the cheapest of all energy sources explored.

- i. True ii. False

QUESTION 2 [5 marks] SLO5

Describe how an existing building in the PNG Unitech may be converted into a net zero energy building.

Hint: focus is on energy.

QUESTION 3 [5 marks] SLO4

Analyze suitability of a nuclear power plant as a sustainable technology. Use criteria other than non-renewability and security issues of uranium. The following are facts related to nuclear power plants:

Uranium content in uranium ore is 0.05-0.2% by weight,

Content of fissile uranium isotope is 0.7% of extracted uranium metal,

Enrichment increases content of fissile uranium isotope to 3-5%,

A reactor needs about 200-500 kg of enriched uranium,

1/4 to 1/3 of a reactor core (60 to 90 fuel assemblies) needs to be changed every 1 to 2 years,

From 1968 to 2017 a total of 276,879 fuel assemblies used in the US are in storage,

It takes spent fuel rods 1000s to tens of 1000s to decay.

QUESTION 4 [5 marks] SLO2

An engineer specifies that one cubic meter of concrete should contain 350, 800, and 1015 kilograms of cement, fine aggregates, and coarse aggregates, respectively. Specific emission rates of cement, fine aggregates, and coarse aggregates are 0.670, 0.010, and 0.035 kilograms of CO₂ for each kilogram of the respective materials.

- (a) Calculate the carbon footprint of a project needing 50m³ of concrete. [2 marks]
 - (b) Explain how can this footprint be reduced. [1.5 marks]
 - (c) Will reducing the footprint increase or decrease construction cost? [1.5 marks]
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