



TECHNICAL UNIVERSITY OF MOMBASA

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Faculty of Engineering and Technology  
Department of Electrical and Electronic Engineering  
UNIVERSITY EXAMINATION FOR:  
Master of Technology in Sustainable Energy Engineering  
ENT 5111 : ENERGY CONVERSION SYSTEMS  
SPECIAL/ SUPPLEMENTARY EXAMINATIONS  
SERIES: SEPTEMBER 2018  
TIME: 2 HOURS

**Instruction to Candidates:**

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt any other **THREE** questions.

Maximum marks for each part of a question are as shown.

**Do not write on the question paper.**

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**Question ONE**

- a) With the aid of suitable diagrams describe the process of ideal Rankine cycle used in modern steam power plants and state its efficiencies. (8 marks)
- b) With the aid of suitable diagrams explain the process of nuclear fusion and highlight its potential benefits for the future of energy production. (12 marks)

**Question TWO**

Describe the following stages of nuclear fuel cycle:

- Mining and Milling (5 marks)
- Enrichment (3 marks)
- Fuel Fabrication (2 marks)

Fuel Burnup

(7 marks)

Spent Fuel Reprocessing

(3 marks)

### Question THREE

a) Discuss in detail the chemistry and process of hydrogen production using Pyrolysis and Co-pyrolysis:

(8 marks)

b) One direct pathway to conversion of solar insolation to electricity is by the use of Photovoltaic cells. With the aid of suitable diagrams discuss their construction and operation.

(12 marks)

### Question FOUR

a) Give **SIX** disadvantages that limit the use of fuel cells compared with other energy conversion systems.

(6 marks)

b) Describe briefly **FOUR** areas where fuel cells find widespread application.

(4 marks)

c) Using suitable diagrams describe the construction chemical reactions and general operating principles encountered for the following types of fuel cells:

i) Alkaline Fuel Cells

(4 marks)

ii) Phosphoric Acid Fuel Cells

(3 marks)

iii) Direct Methanol PEM Fuel Cells

(3 marks)

### Question FIVE

a) The Athabasca oil sands in Alberta, Canada are a controversial fuel source. Discuss the procedure for bitumen extraction from its raw materials and highlight the potential dangers that it poses to the natural environment.

(12 marks)

b) Give a detailed description of the following coal liquefaction methods

i) Indirect

(4 marks)

ii) Direct

(4 marks)