



TECHNICAL UNIVERSITY OF MOMBASA

**FACULTY OF APPLIED AND HEALTHY SCIENCES
DEPARTMENT OF MATHEMATICS AND PHYSICS**

**UNIVERSITY EXAMINATION FOR THE DEGREE OF
BACHELOR OF TECHNOLOGY IN RENEWABLE ENERGY (BTRE)**

**APS 4331: SOLAR AND HYDRO ENERGY
SPECIAL/ SUPPLIMENTARY EXAMINATIONS**

SERIES: September 2018

TIME: 2 HOURS

DATE: September 2018

INSTRUCTION TO CANDIDATES

You should have the following for this examination.

-Answer Booklet, examination pass and student ID.

This paper consists of FIVE questions.

Answer question ONE (COMPULSORY) and ANY other TWO questions.

The maximum marks for each question is shown.

Do not write on the question paper.

Question One (30 marks)

- a) Explain the meaning of the following concepts as applies to renewable energy
 - i) Solar concentrator (2marks)
 - ii) Payload (2marks)
 - iii) Solar collector (1mark)
 - iv) Solar tracker (1mark)
- b) Explain four advantages of fixed mount payloads to tracker connected ones (8marks)
- c) What is a Single Axis Tracker? Give five examples (6marks)
- d) State two factors that affect the conversion efficiency of the incident solar radiation into the mechanical work (2marks)
- e) In evacuated tubular collector unit of solar concentrator, the energy transfer by the collector sealed fluid takes place in four steps. Outline these steps (8marks)

Question Two (20 marks)

- a) Describe a simple solar-thermal-air collector and how it works (4marks)
- b) State four applications of solar air heat devices (4marks)
- c) Solar air heating collectors are commonly classified by either their air-ducting methods or by their outer surface. Describe these classifications. (12marks)

Question Three (20 marks)

- a) Define the following as applies to solar energy
 - i) solar cell (3marks)
 - ii) photovoltaic effect (3marks)
 - iii) semiconductor material (3marks)
- b) Describe the mechanism of making a p-n junction of solar cell (4marks)
- c) With illustration, describe the working principle of a p-n junction (5marks)
- d) State two types of silicon solar cells based on their structures (2marks)

Question Four (20 marks)

- a) Explain the following concept in relation to tidings.
 - i) Tidal steam generator. (2marks)
 - ii) Tidal barrage (2marks)
 - iii) Dynamic tidal power (2marks)
- b) State and briefly describe five forms of ocean energy and power (14marks)

Question Five (20 marks)

- a) To efficiently convert solar energy into mechanical energy
- i) What factors do the solar-thermal energy receiver depend on (3marks)
 - ii) Given the incident solar flux ($\eta_{optics} ICA$) and flux lost ($A\epsilon\sigma T_H^4$) determine the conversion efficiency of the solar radiation into mechanical energy where C is concentration multiplying factor, A is reradiating area, I is solar flux and σ is thermal conductivity of the receiver (other constants are standard) (7marks)
- b) Efficiency of a solar collector depends on the ability to absorb heat and the reluctance to lose it once absorbed. State ways in which the collector loses energy
- i) Optically (3marks)
 - ii) Thermally (3marks)
- c) The choice of the collector depends on four factors. State these factors (4marks)