INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF SCIENCE AND TECHNOLOGY

END OF SEMESTER EXAMINATIONS - DECEMBER 2025

PROGRAMME: BSEM
YEAR/SEM: YEAR 3/SEMESTER 1
COURSE CODE: BSE3101
NAME: RENEWABLE ENERGY TECHNIQUES

DATE:
TIME:

INSTRUCTIONS TO CANDIDATES:

SECTION A

Attempt only ONE question

Question 1:

a. State and compare the operation of the common turbine technologies used in hydro power generation systems. (09 marks)

b. Explain any three factors that influence PV cell efficiency. (06 marks)

c. Define energy efficiency and give at least four (4) advantages. (05 marks)

d. In which ways do we use coal? (08 marks)

e. Explain the petroleum value chain. (12 marks)

Question 2:

a. Briefly explain the three (3) technologies used in hydro power generation. (12 marks)

b. Mention the types of hydroelectricity dams. (04 marks)

c. Mention the biomass sources used for energy generation. (04 marks)

d. What does the term ‘levelized cost of energy’ mean? (02 marks)

e. Mention the processes that take place when a solar cell is exposed to solar irradiation. (03 marks)

f. Assuming Water from a river is flowing at $105m^3s^{-1}$ down a smooth pipe, falling 35m into a turbine.

i. Calculate how much power is available? (5 marks)

ii. If 8% of the power is lost due to frictional losses, how many houses having a daily electricity use of 7kWh would this hydropower plant supply? (10 marks)

SECTION B

Attempt any THREE questions

Question 1:

a. In relation to solar, define the following terms: (2 marks each) (10 marks)

i. Nominal Power

ii. Solar Cell Efficiency

iii. Rated Voltage

iv. Rated Current

v. Open Circuit Voltage

b. Why is it important to consider the maximum system voltage while designing solar systems? (02 marks)

c. Discuss the major components of the solar system. (08 marks)

Question 2:

a. Mention any five (5) harmful emissions that results from combustion of coal. (05 marks)

b. Give any five (5) ecological impacts of hydroelectric power plants. (05 marks)

c. Explain the components of a Hydroelectric dam indicating their roles. (10 marks)

Question 3:

Explore the merits and demerits of Geothermal Energy.

Question 4:

Illustrate and explain the design and operation of an impoundment type of hydro power plant.

Question 5:

Discuss the steps involved in the extraction of crude oil.

Question 6:

What processes convert biomass to energy?

Question 7:

Describe the different types of coal.

Question 8:

a. Mention the advantages and disadvantages of using solar. (10 marks)

b. In relation to hydro power, define the following terms: (2 marks each) (10 marks)

i. Capacity factor
ii. Gross potential
iii. Installed capacity
iv. Technical potential
v. Actual Generation

Question 9:

a. What are the advantages and disadvantages of using coal? (10 marks)

b. Write short notes on the following: (05 marks each) (10 marks)

i. Pumped-storage hydropower facilities
ii. Concentrating Solar-Thermal Power (CSP).

Question 10:

You are required to analyse the external parameters of the solar module using the following data:

- Open-Circuit Voltage (Voc) 44.4V
- Power input (Pin) 950W
- Short Circuit Current (Isc) 4.2A
- Panel size 950mm x 550mm
- Number of cells 72

- Rated voltage (Vmp) 39V
- Rated Current (Imp) 3.4A

Calculate:

a. the nominal power of this solar module (5 marks)

b. the efficiency of the solar panel (5 marks)

c. the current density of the solar panel (5 marks)

d. the open circuit voltage of a single solar cell if all cells are connected in series (5 marks)

Question 11:

Given that the nominal voltage of the PV system is 48v, study the table below and answer the following questions.

AC devices	Power Ratings (kW)	Duration of daily use (minutes)	DC devices	Power Ratings (kW)	Duration of daily use (minutes)
Microwave	1.3	45	Fridge	0.13	880
Washing Machine	1.2	90	Flat Iron	2	18
Computer	0.06	360	Television	0.11	420
Blender	0.43	23	Radio	0.09	490

a) Assume that the inverter is 93% efficient, calculate the:

(i) DC load electricity requirements in Ah per day (5 marks)

(ii) AC load electricity requirements in Ah per day (5 marks)

b) Find the total electricity requirements (in Ah per day), assuming 6% of the energy is lost as a result of cable joints.

(5 marks)

Elaborate on the advantages and disadvantages of using coal as the main source of energy. (5marks)

Question 12:

Examine the global and national trends in energy use and explain how these trends have contributed to both the energy crisis and the current transition toward cleaner energy systems.