



## TECHNICAL UNIVERSITY OF MOMBASA

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*Faculty of Engineering and Technology in Conjunction with Kenya Institute of  
Highways & Building Technology (KIHBT)*

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

**UNIVERSITY EXAMINATION FOR 2017/2018:**

**HIGHER DIPLOMA IN TECHNOLOGY**

**ELECTRICAL POWER ENGINEERING**

**ERE 3230: RENEWABLE ENERGY**

**END OF SEMESTER EXAMINATION**

**SERIES: DECEMBER 2017**

**TIME: 2 HOURS**

**DATE:** Pick DateSelect MonthPick Year

### **Instructions to Candidates**

You should have the following for this examination

*-Answer Booklet, examination pass and student ID*

This paper consists of **FIVE** Questions; each question carries 20 Marks. Attempt any **THREE** Questions.

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

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## QUESTION ONE

- a)
- i. State any THREE technical challenges associated with Solar PV energy systems.
  - ii. Differentiate with the aid of a sketch between Solar Direct Heating and Solar PV energy systems.
  - iii. Explain the precautionary measures to be observed during Solar PV energy system installation. **(10 Marks)**
- b) Given the following load base condition:
- I. 10 Fluorescent lamps (36 watts each), for 12hrs a day.
  - II. General Purpose appliances (120W in Total) for 6hrs a day.
- Apply common applied factors of efficiency and duration, as well as local prices to design a solar PV system and estimate:
- i. The number of PV panels
  - ii. The dimensions of battery bank
  - iii. Inverter rating
  - iv. Cost estimation of the system. **(10 Marks)**

## QUESTION TWO

- a)
- i. State any THREE functions of Geothermal Development Company (GDC) in Kenya.
  - ii. Explain any TWO negative environmental consequences associated with geothermal energy resources.
  - iii. With the aid of a well labeled schematic describe the layout of a Geothermal Power Generating Station. **(10 Marks)**
- b) A new Geothermal plant has been discovered having an equivalent mass of hot rocks totaling 1 tonne and calorific value of 10,000kcal/Kg. The plant generates 4000kWhr per day. The turbine and the electrical efficiencies are 95% and 96% respectively. Take 1kWhr = 860kCal. Determine:
- i. The overall plant efficiency.
  - ii. The efficiency of the geothermal well.
  - iii. The annual fuel consumption of an equivalent 93% efficiency Coal Plant having calorific value of 3000kCal/Kg. **(10 Marks)**

## QUESTION THREE

- a)
- i. Explain any TWO major conditions which must be met before a mini-hydro power station is installed.
  - ii. Highlight THREE challenges faced in running an off-grid mini-hydro power station.
  - iii. Illustrate with the aid of a sketch the layout of a Pico hydro-electric power plant. **(10 Marks)**
- b) A small river run off electric plant with pondage has the following data:

Installed Capacity = 5MW  
Overall Efficiency = 80%

Water Head,  $H = 10\text{m}$   
Load Factor = 40%

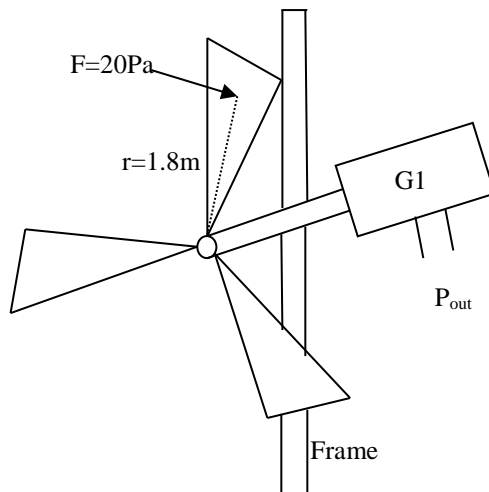
- i. Determine the minimum river discharge in  $\text{m}^3/\text{s}$  required for the plant.
- ii. On a particular day the discharge changed to  $10\text{m}^3/\text{s}$ , calculate the load factor the plant can supply. **(10 Marks)**

#### QUESTION FOUR

a)

- i. State **THREE** advantages of Wind over Hydro energy systems.
- ii. Explain any **TWO** disadvantages of Availability Based Tariff (ABT) in energy billing system.
- iii. With the aid of sketches compare the performances of **TWO** types of wind turbines. **(10 Marks)**

- b) A uniform wind thrust of  $20\text{Pa}$  hits a three plate turbine (**Figure Q4 below**) each with an effective radius of a total area of  $10\text{m}^2$  and effective radius of  $1.8\text{m}$  to turn it at an average speed of 1500 revolutions per minute.



**Figure Q4**

Given that a 4 pole rotating field synchronous generator is connected via the shaft, and that the plant has mechanical and electrical efficiencies of 60% and 90% respectively, calculate:

- i. The frequency of the output voltage.
- ii. The power output of the plant.
- iii. The cost per unit of electricity produced for a Garden having 50 such plants and operated 6 Hours a day. Total expenses are KSh. 20 Million per annum.

**(10 Marks)**

## QUESTION FIVE

- a)
- i. Explain THREE major reasons why several industrialized countries in the world are shutting down their Nuclear Power Plants.
  - ii. State TWO challenges faced in the establishment of a Biomass Plant.
  - iii. With the aid of an illustration show the setup of a Biomass Power Generating Plant. **(10 Marks)**
- b) Biomass with a calorific value of 6400kCal/Kg was used to supply heat to a 100MW steam station. Given that the thermal efficiency and electrical efficiencies of the station was 30% and 92% respectively, take 1kWhr = 860kCal to calculate:
- i. The Biomass consumption per hour when the station is delivering its maximum output.
  - ii. The value of loss due to inefficiency in KSh. if Biomass is worth KSh. 8.00 per Kg.
  - iii. The cost of Biomass required to run the station for 4 hours a day for a year while delivering its maximum output. **(10 Marks)**