



**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING**

**TEST -1**

**Even Semester:** 2018-19

**Date:** 05 March 2019

**Course Code:** MEC 217

**Time:** 1 Hour

**Course Name:** Renewable Energy System

**Max Marks:** 40

**Programme & Sem:** B.Tech (MEC) & VIII (Group- I)

**Weightage:** 40%

**Instructions:**

- (i) Read the question properly and answer accordingly.
- (ii) Question paper consists of 3 parts.
- (iii) Scientific and Non-programmable calculators are permitted

**Part A**

Answer **all** the Questions. **Each** question carries **four** marks.

(4Qx4M=16M)

1. How is "Per Capita Energy Consumption" related with Standard of living?
2. Define the terms : a) Hour Angle b) Solar Azimuth Angle
3. Describe the flat plate collector with the help of a suitable diagram :-
4. Enumerate the different main applications of solar energy.-

**Part B**

Answer **both** the Questions. **Each** question carries **six** marks.

(2Qx6M=12M)

5. For New Delhi ( $28^{\circ} 35^1$  N,  $77^{\circ} 12^1$  E), calculate the Zenith angle of the sun at 2.30 PM on February 2015. The Standard IST latitude for India is  $81^{\circ} 44^1$  E
6. Data for a Flat plate collector used for heating are given below

| FACTOR                               | SPECIFICATION                 |
|--------------------------------------|-------------------------------|
| Location & Latitude                  | Ahmadabad $23^{\circ} 03^1$ N |
| Day & time                           | December 22 , 13 PM           |
| Average Intensity of solar radiation | 800 W/ m <sup>2</sup>         |

|   |                          |
|---|--------------------------|
| Collector tilt                              | Latitude + 15°           |
| Heat removal factor for collector           | 0.810                    |
| Transmittance of glass                      | 0.88                     |
| Absorptance of the glass                    | 0.90                     |
| Top loss coefficient( $U_L$ ) for collector | 7.88 W/m <sup>2</sup> °C |
| Collector fluid temperature                 | 60°C                     |
| Ambient temperature                         | 15°C                     |

Calculate

- Solar altitude angle
- incident angle and
- Collector efficiency

### Part C

Answer the Question. Question carry **Twelve** marks.

(1Qx12M=12)

- Design a PV water pumping system for daily requirement of 6000 litres of water from a depth of 32 m. Use the following data :

Solar PV module used: "BP380" from BP Solar

Peak power = 80 W

Voltage at peak power ( $V_m$ ) = 17.6 V

Current at peak power ( $I_m$ ) = 4.55 A

Operating factor = 0.75

(Due to various reasons, solar panel does not operate at its rated peak power)

Mismatch factor = 0.85

(This factor arises due to operation at a point other than maximum power, if MPPT is use, this factor may be assumed to be unity)

Mono block (Pump + motor) efficiency = 30 %

Water density = 1000 kg / m<sup>3</sup>

Sunshine hours = 4h/day (peak of 1000 W/m<sup>2</sup> equivalent)



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Roll No

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TEST 2

Even Semester: 2018-19

Date: 15 April 2019

Course Code: MEC 217

Time: 1 Hour

Course Name: Renewable Energy Systems

Max Marks: 40

Program & Sem : B.Tech & VIII Sem (Group -1)

Weightage: 20%

**Instructions:**

- (i) Scientific and Non-programmable calculators are permitted.
- (ii) Steam table are permitted.

**Part A**

Answer **all** the Questions. **Each** question carries **four** marks. (3Qx4M=12)

1. What are the factors responsible for distribution of wind energy on the surface of earth?
2. What raw materials can be used for production of Biogas? What is meant by MSW ?
3. What are the merits and demerits of geothermal energy?

**Part B**

Answer **both** the Questions. **Each** question carries **eight** marks. (2Qx8M=16)

4. Calculate the rotor radius for a wind turbine operating at wind speed of 7 m/s to pump water at a rate of  $5\text{m}^3/\text{h}$  with a lift of 6 m. Also calculate the angular velocity of the rotor

Use the following data:

Water pump efficiency = 45 %,

Efficiency of rotor to pump = 80%,

Power coefficient = 0.25,

Tip seed ratio =1.11,

Air density =  $1.2 \text{ kg/m}^3$

5. A 100 MW vapour dominated system uses saturated steam from a well with shut off pressure of 27.46 bar steam enters the turbine at 5.49 bar and condenses at 0.137 bar pressure. The turbine polytrophic efficiency is 0.82 and the turbine-generator combine mechanical and electrical efficiency is 0.90. The cooling tower exit is at  $21^{\circ}\text{C}$ . Calculate the necessary steam mass flow rate and the plant efficiency.

### Part C

Answer the Question. The Question carries **twelve** marks.

(1Qx12M=12)

6. A group of 12 families in a village plans to install a KVIC Bio gas plant for energy needs of cooking, bathing and lighting. Calculate the volume of digester and the number of cattle required. Use the following data:

- Total no of persons = 3 adults and 2 children in each family
- Mass of wet cow dung produced/cattle/day = 10 kg
- Heat energy required for cooking daily food = 1758 k J/person/day
- Heat energy required for breakfast, snacks etc may assumed to be half of that required for cooking
- Assume 20 Litres of water at 45<sup>0</sup>C is required for bathing per person
- Assume 2 lamps of 40 W are used for 3 hrs daily by each family for lighting.
- Gas burner efficiency 60%
- LCV of Biogas = 17500 kJ/m<sup>3</sup>
- Gas yield of cow dung = 0.34 m<sup>3</sup> /kg
- Density of slurry = 1090 kg/m<sup>3</sup> retention period = 45 days

Assume the standard values of data wherever required:

6. The following data are used for design of a solar water heater:

|                         |                              |
|-------------------------|------------------------------|
| Solar radiation         | : 6 KWh /m <sup>2</sup> -day |
| Hot water required      | :1000 Liters/day             |
| Hot Water temperature   | :55 °C                       |
| Cold water temperature  | :15 °C                       |
| Specific heat for water | :4.18 kJ/kgK                 |

- a) If a single collector has an area of 2.5 m<sup>2</sup> and its efficiency is 0.55, find the total area required and number of solar collector modules.
- b) The cost of solar collector is Rs. 2,00,000 . An electrical heater is used with efficiency of 0.95 and cost of 1 unit = 1 kWh = Rs.6, calculate the payback period, if the solar water heater is used for 300 days per year.

7. Write short Notes on: a) OTEC Systems

b) Hydrogen fuel cell

c) Thermoelectric Power generation

Roll No



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**END TERM FINAL EXAMINATION**

**Even Semester:** 2018-19

**Course Code:** MEC 217

**Course Name:** Renewable Energy Systems

**Program & Sem:** B.Tech & VIII Sem (Group-I)

**Date:** 21 May 2019

**Time:** 3 Hours

**Max Marks:** 80

**Weightage:** 40%

**Instructions:**

- i. Draw neat sketches wherever necessary  
ii. Assume suitable data wherever necessary

**Part A**

Answer **all** the Questions. **Each** question carries **one** mark.

(20Qx1M=20M)

1. Objective type Questions:-

i. Air mass ratio is minimum

a) When the Sun is at Zenith

b) at sunrise

c) at sunset

d) at 06.00 GMT

ii. On 20 February 2015 , the declination angle,  $\delta$  , will be

a) Zero

b) +23.45°

c) -23.45°

d) -11.58°

iii. A solar cell is basically:

a) a voltage source, controlled by flux of radiation

b) a current source, controlled by flux of radiation

c) an uncontrolled current source

d) an uncontrolled voltage source

iv. When solar radiation falls on earth surface, temperature of:

a) land mass rises faster than water mass

b) land mass rises slower than water mass

c) land mass and water mass rises uniformly

d) only land mass increases & water remains at fixed temperature

v. Wind blows because of :

a) difference in temperature

b) difference in latitude

c) difference in longitude

d) difference in surface roughness

- vi. Windmill works on the principle of :
- a) Rotation    b) momentum    c) gravitation    d) collision
- vii. During day time the surface wind blows :
- a) from sea to land                      b) from land to sea  
c) on sea only                              d) on land surface only
- viii. Storage of biomass energy is :
- a) very difficult    b) inbuilt feature    c) expensive                  d) impossible
- ix. Biogas is predominantly :
- a) hydrogen        b) carbon dioxide    c) carbon monoxide    d) methane
- x. Bi-diesel is :
- a) Obtained from fermentation of sugars      b) obtained from pyrolysis process  
c) Exudates of plants                                  d) an upgraded vegetable oil
- xi. Which of the following is not a biomass?
- a) Plants and trees    b) Wood            c) Cattle dung    d) Water
- xii. The process in which waste material is reduced to ashes is called :
- a) Biodegradation    b) composting    c) recycling        d) incineration
- xiii. Main disadvantage of geothermal energy is :
- a) Large area requirement                          b) low efficiency  
c) drilling operation is noisy                      d) high cost
- xiv. Ocean thermal energy conversion systems to generate power is most suitable in:
- a) Sub-tropical region                                  b) tropical region  
c) cold region    d) moderate climate region
- xv. Ocean waves are indirectly caused by :
- a) Gravitational force of moon  
b) gravitational force of sun  
c) solar energy  
d) geothermal
- xvi. Cogeneration means :
- a) Power production using binary cycle  
b) power production using two types of primary energy sources.  
c) generation of ac as well as dc power in the same installation  
d) generation of electricity and heat in a single installation
- xvii. At solar noon, the hour angle is :
- a) +90°            b) -90°            c) zero            d) +180°
- xviii. The collection efficiency of Flat plate collector can be improved by:
- a) putting a selective coating on the plate  
b) evacuating the space above the absorber plate

- c) both a) & b)  
d) None of the above
- xix. The efficiency of various types of collectors \_\_\_\_\_ with \_\_\_\_\_ temperature.  
a) increases, decreasing                          b) decreases, increasing  
c) remains same, increasing                      d) depends upon type of collector
- xx. Solar radiation flux is usually measured with the help of a :  
a) Anemometer    b) Pyranometer    c) Sunshine recorder    d) All of the above

### Part B

Answer **all** the Questions. **Each** question carries **eight** marks. (3Qx08M=24M)

- The observed difference between the high and low water tide is 8.5 m, for a proposed tidal site. The basin area is about 0.5 sq.km which can generate power for 3 hrs in each cycle. The average available head is assumed to be 8 m, and the overall efficiency of the generation to be 70%. Calculate the power in h.p at any instant. Average specific weight of seawater is assumed to be 1025 kg/ m<sup>3</sup>
- A thermoelectric generator operates between 250°C and 550°C. The average value of the Seebeck coefficient is  $-200 \times 10^{-6}$  V/K, the generator resistance is 0.0023 ohm, optimum value of figure of merit is  $1.85 \times 10^{-3}$  °K and the thermal conductance is 0.035 W/ °C. Find the optimum efficiency and the thermal efficiency for maximum power output:
- Calculate the angle made by the beam radiation with normal to a flat plate collector, pointing due south located in New Delhi (28°38' N, 77°17' E) at 9.00 Hour, solar time on December 1. The collector is tilted at angle of 360 with the horizontal.

### Part C

Answer **all** the Questions. **Each** question carries **twelve** marks. (3Qx12M=36M)

- A single basin type tidal power plant has a basin area of 3 km<sup>2</sup>. The tide has an average range of 10 m. Power is generated during flood cycle only. The turbine stops operating when the head on it falls below 3 m. Calculate the average power generated by the plant in single filling process of the basin if the turbine generator efficiency is 65%. Estimate the average annual generation of the plant:-