Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

V SEMESTER B.TECH (MECHANICAL ENGG.) END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: NON CONVENTIONAL ENERGY SOURCES [MME 4025]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Describe with a neat sketch the process of conversion of solar energy into electricity using a parabolic collectors and a suitable working fluid. **4**

1B. Draw the solar radiation geometry clearly showing all the relevant solar earth angles. **3**

1C. Find the monthly average hourly global radiation on a horizontal surface at the location ($20^{o}35'$N, 77^{o}E) for the time 0930-1000h (IST) using the following data:

Month: March 15^{th}

Average sunshine hours per day = 9

Sunrise hour angle = 95.18^{o}

Equation of time correction = - 4min

Standard longitude for the location = 82.5^{o}E.

Monthly average solar radiation indicated by a pyranometer at the location is 600W/m^2.Assume solar constant as 1367 W/m^2 and constants a=0.698 and b= 0.386. **3**

2A. A liquid flat plate collector with single glass cover has the following data:

Length of collector=1.2m

Width of collector = 1.1m

Extinction coefficient of glass = 12/m

Glass plate thickness = 2mm

Refractive index of glass to air=1.526

Beam radiation flux = 450W/m^2

Diffuse radiation flux = 200W/m^2

Tilt factor for beam radiation=0.9384

Tilt factor for diffuse radiation=0.9741

Tilt factor for reflected radiation = 0.0052

Transmissivity based on reflection-refraction for beam radiation= 0.8445

Angle of refraction for beam radiation = 18.72^{o}

Angle of incidence for diffuse radiation = 60^{o}

Diffuse reflectivity of cover system = 0.2

Glass cover emissivity/absorptivity = 0.8

Find the incident solar radiation flux absorbed by the absorber plate. **4**

2B. Define and give the expressions for all types of tilt factors. **3**

2C. What are the effects on performance of liquid flat plate collectors for the following factors:

i) Fluid inlet temperature

ii) Spacing

iii) Selective surfaces **3**

3A. At a given site the wind velocity is measured as 12m/s at a height of 15m above the ground. At a height of 5m from the ground, the wind velocity is found to be 50% less than that at 15m height. The density of air is $1.22kg/m^3$ at both sites. The wind turbine diameter is 90m and the turbine speed is 100rpm. If the wind turbine is to be installed at both the heights, find:

I) Ratio of maximum axial force on the turbine at each site.

II) Ratio of maximum circumferential force on turbine at each site. **4**

3B. Sketch and explain a hybrid power generating system that uses differential temperature available in very large water bodies. **3**

3C. With neat sketch explain the working of an ocean wave energy converter that makes use of only potential energy of the ocean waves. **3**

4A. With a neat sketch explain the working of up draught gasifier with all the reactions. **4**

4B. Explain in a biomass digester:

I) Why maintaining total solid content is critical

II) Diameter to depth ratio is important **3**

4C. A certain petro- thermal process uses involves flashing of hot water to generate power. How would you modify this to include one more turbine that would run using flashed vapors. Explain with a neat sketch. **3**

5A. Sketch and label the Magneto-hydrodynamic system for power generation in which combustion gas is passed through the magnetic field for power generation. Explain the principles used in MHD. **3**

5B. An ocean wave energy plant converts energy from a 75 m width of ocean surface with wave amplitude of 1.5 m, wave period= 5 sec. The energy conversion efficiency is 30%. Calculate the power rating if ρ= 1025 kg/m^3. **3**

5C. A 100kW, 115V, thermoelectric generator operates between 1500K and 1000K. The material properties are:

ρ_{pn}= 0.0012 V/K, kp= 0.02 W/cmK, kn= 0.03 W/cmK, ρ_p= 0.01 Ω.cm,

ρ_n= 0.012 Ω.cm

For an optimum design A_p= 43.5 cm^2, A_n= 48.6 cm^2, L_A= L_B= 0.49 cm and the current density in the elemenst is limited to 20 amp/cm^2, calculate:

- Maximum efficiency of the thermoelectric generator
- No. of thermocouples in series
- Open circuit voltage
- Heat input and heat rejected at full load

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