Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (MECHANICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: RENEWABLE ENERGY SYSTEMS [MME 447]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** 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 dish concept 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 = 15/m
Glass plate thickness = 2mm
Refractive index of glass to air=1.526
Beam radiation flux = 500W/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 **4**
Find the incident solar radiation flux absorbed by the absorber plate.

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

2C. Using a ray diagram for transmission through a single cover considering reflection- refraction, find the relation for transmissivities of two components of polarization. **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. **3**

4B. Explain a biomass digester:

I) Why C/N ratio is 30:1
II) Supernatent layer **4**

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. With a neat sketch explain the working of PEM fuel cell. **3**

5B. 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**

5C. What is “Seebeck effect” and “Peltier effect” with suitable examples? **4**

6A. Mention the limitations of bulb turbine and tube turbine. **2**

6B. 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**

6C. A thermionic converter is operating with a Thoriated + Tungsten emitter at 1900^0K with a space- charge barrier energy of 0.3 eV and a collector barrier energy of 0.5 eV. Find the emitter area needed to produce 100W if
ε_c= 0.04 x 10^6 A/m^2k^2, φ_c= 2.7 eV
ε_a= 0.001 x 10^6 A/m^2k^2, φ_a= 1.5 eV
k= 1.38 x 10^{-23}, φbc= 0.3, φba= 0.5 eV, e= +1.6 x 10^{-19}
Also find η_{th}, by neglecting radiation loss and power loss due to wire resistance. **5**