Renewable Energy Engineering (2181910)
Paper Analysis

Chapter 1 – Scenario of Renewable Energy (RE) Sources

Sr. No.	Questions	APR – 17	NOV – 17
	Theory		
1.	Discuss in brief limitation of renewable energy.	02	
2.	Discuss in brief advantages of renewable energy.	02	
3.	List the advantage and limitation of Renewable Energy.		04

Chapter 2 – Solar Energy

	Theory		
1.	Derive the expression of collector efficiency factor, heat removal factor and useful heat gain for the air heater.	08	
2.	Explain the working of indirect solar drying system with neat sketch. Also discuss the advantages.	06	
3.	Derive the expression of collector efficiency factor, heat removal factor and useful heat gain for the cylindrical parabolic collector.	08	
4.	Explain the construction of solar pond with neat sketch.	06	
5.	Define terms : Angle of Incidence, Declination, Solar constant		03
6.	Explain construction and working of Pyranometer with schematic diagram.		07
7.	Explain working of solar still with neat sketch.		04
8.	List the factors affecting for the performance of flat plate collector.		03
9.	Explain working of solar pond.		04
10.	Define term: Solar Azimuth Angle, Solar Altitude Angle, Hour Angle		03
	Example		
1.	A researcher wants to calculate incidence angle for surface tilted at 30° with horizontal from the data available for horizontal surface:- Angle of incidence for horizontal surface : 45.6° Surface facing 10° East of South at location Date : 23rd December (Non leap year) Standard time of location: 12 p.m. Day length for horizontal surface: 10.7 hrs.	08	

2.	The following data refers to liquid flat plate collector, Collector tilt = 22.15°, Available radiation = 1100 W/m^2, Absorber plate area = 2.1 m^2, Plate emissivity = 0.12, Glass cover emissivity = 0.88, Number of covers = 2, Mean plate temperature = 68° C, Flux available at absorber plate = 800 W/m^2, Side loss coefficient = 0.8 W/m^2-K, Bottom loss coefficient = 0.6 W/m^2-K, Inlet water temperature = 30° C, Ambient air temperature = 25° C, Wind speed = 1.8 m/s, Mass flow rate of water = 62 kg/hr. Determine, (1) Overall heat loss coefficient, (2) Outlet water temperature from the collector (3) Efficiency of collector. Use Test et al. Correlation. Take area of collector is 10% more that area of absorber plate.	07	
3.	The latitude of Srinagar is 34°. Find day length in hrs. When sunlight is available on 1st July.		03
4.	A compound parabolic collector has an acceptance angle of 22°. The absorber surface of the collector is flat and its width is 12 cm. Find out the followings: (i) Concentration ratio of a collector (ii) The width of aperture and height of collector (iii) Surface area of the concentrator taking length of the collector = 1m.		07
5.	A cylinder parabolic collector having 2.5 cm width and 10 m long is used to heat fluid entering at 150 0C with a flow rate of 7.5 kg/min (C_{pf} = 1.25 kJ/kg °C . The diameter of the absorber tube is 6.5 cm which is covered with glass tube. Take following data: Solar intensity = 700 W/m^2 Atmosphere temperature = 30 °C Product of absorptivity and transmissivity of absorbing surface for radiation $(\alpha\tau)_{ab}$ = 0.8, Reflectivity of radiation (r_r) =0.93, Transmissivity of glass (τ_g) = 0.85. Also take collector efficiency factor = 0.85, Heat lost coefficient = 8W/m^2 0C. Heat transfer coefficient inside the tube is 1 and tilt factor is also 1. Find: 1. Useful heat gain and exit temperature of the fluid. 2. Collector efficiency.		07

Chapter 3 – Wind Energy

Theory

1.	Derive the one dimensional momentum theory and Beltz's limit for the wind mill. Also state the assumption in theory and draw the variation of pressure and velocity in wind mill.	07	
2.	Explain with neat sketch the geometry of airfoil terminology. Also explain with neat sketch indicating the direction of lift force, drag force, pitching moment coefficient.	07	
3.	List the basic component of wind mill and draw the wind energy conservation system.		03
4.	Explain importance of drag and lift force in wind power generation.		04

5.	Describe the effect of different parameter on the power generating capacity of wind mill. Also explain control mechanism of a wind turbine.		07
6.	Prove that the maximum turbine output can be achieved when $V_e = V_i/3$, Where V_i and V_e are upstream and downstream velocities of the wind.		07

Example

1. The following table shows the various angle of attack, lift and drag coefficient for airfoil DUV400. Find the design angle of attack. **06**

Angle of attack	2	4.1	6.2	8.1	10.2	11.3	12.1	13.2	14.2	15.3
Lift Coefficient	0.3	0.54	0.79	0.9	0.93	0.92	0.95	0.99	1.01	1.02
Drag Coefficient x 10^{-2}	1.16	1.44	1.46	1.62	2.74	3.03	3.69	5.09	6.48	7.76

Calculate lift and drag force per unit length of blade for the following data.

Design wind speed = 10 m/sec Atmospheric pressure = 1.01bar

Chord length = 15 cm. Atmospheric temperature = 30°C

Chapter 4 – Bio Energy

Theory

1.	Discuss the following factors affecting the biogas generation (1) pH (2) Nutrient (3) Temperature (4) Diameter to Depth ratio (5) Carbon – Nitrogen ratio.	05	
2.	Explain with neat sketch the three stage scheme for methane fermentation.	05	
3.	Distinguish between Fixed dome plant and floating dome type biomass plant.		03
4.	Explain upward draft gasifier with diagram.		04

Chapter 5 – Ocean Energy, Geothermal energy, MHD Power generation

Theory

1.	Explain with neat sketch the working of hybrid OTEC system.	05	
2.	Explain with neat sketch the vapour dominated geothermal system.	04	
3.	Explain with neat sketch the basic and working principle of MHD generator.	05	
4.	Explain with neat sketch the liquid dominated geothermal system.	04	
5.	List the geothermal resources. Explain binary fluid hydrothermal system.		07
6.	Explain single basin, two-way tidal power plant.		04
7.	State the principle of Ocean Thermal Energy Conversion (OTEC). Explain working of closed cycle OTEC system.		07
8.	Explain basic principle of Magneto Hydro Dynamic generation.		04

Chapter 6 – Economic Analysis

Theory

1.	Write a short note on solar saving.	04	
2.	Define (1) Payback time (2) Return on investment (3) Life cycle cost	03	
3.	List the need for economic analysis of renewable energy system.		03
4.	State the objectives of clean development mechanism. Explain clean development mechanism project cycle with flow diagram.		07

Example

1.	For an 11,00,000/- investment in solar energy equipment which meets 56% of annual load of 156 GJ. If first year fuel cost is Rs. 800 per GJ and expected to inflate at 10% per year. Calculate (1) undiscounted payback time (2) Discounted payback time if discount future cost at rate 8%.	04	
2.	For a non-solar process, using fuel only, calculate the present worth of fuel cost over 20 years if 1st year's cost is Rs. 125500/-. The market discount rate is 8% per year and fuel cost inflation rate is 10% per year.	04	
3.	What is the annual payment and present worth of all interest payment on mortgage, if solar system is installed having worth Rs.11,00,000/- which is to be financed by a 10% down payment with the balance borrowed at an annual interest rate of 9% for 20 years? The payments are to be made at the end of the year. The market discount rate is 8%.	09	
4.	A proposed insulation system for a house to be heated is expected to save fuel cost of Rs. 2000 in first year. The fuel prices are expected to increase by Rs. 20% per year and best alternative investment with yield 10% per year. Find the total saving from this proposed system expressed in current value. Take life of the system is 15 years.		04
5.	Compute the annual cost of a solar energy system with the characteristics tabulated below.		03
6.	A solar PV system consisting with two lamps, a battery and other associated components cost Rs. 55000. The cost of conventional energy saved due to its installation is Rs. 4000 in the first year and this cost inflates at the rate of 5 % per year. Assume discounting rate is 9%. Calculate the payback period of the system with and without discounting.		07

Factor	Specification
Expected system lifetime t (Yr.)	20
Discount rate (%)	8
Collector area A_c (m^2)	20
Collector cost (Rs/ m^2)	100
Storage cost (Rs/ m^2)	6.25
Cost of control system (Rs.)	100
Miscellaneous cost (Rs.)	200 + (5 A_c)
Capital recovery factor for 20 years at 8 %	0.102