Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI(NEW) EXAMINATION – WINTER 2022

Subject Code:3161914 Date:16-12-2022

Subject Name:Renewable Energy Engineering

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Justify the need to explore Renewable energy in the context of the latest energy generation and energy consumption data for India	**03**
	(b)	Explain the following terms : i) Air mass ii) Solar constant iii) Angle of incidence iv) Hour Angle	**04**
	(c)	Derive an expression for maximum power, maximum torque, and maximum torque, and maximum axial thrust available from a wind turbine from basic principles	**07**
Q.2	**(a)**	Explain the working principle of solar photovoltaic cell	**03**
	(b)	Calculate the number of daylight hours in New Delhi on 22 December 2021. Take latitude as $28^0 35'$ N	**04**
	(c)	Explain with a neat sketch, the principle, construction, and working of the Pyranometer.	**07**
		OR	
	(c)	Explain in detail the parameters affecting the performance of solar thermal devices.	**07**
Q.3	**(a)**	Define the following terms: i) Tip Speed Ratio ii) Solidity iii) Torque coefficient	**03**
	(b)	Explain the concept of lift and drag in context to the wind turbine blade.	**04**
	(c)	Explain with a neat sketch, the construction, and working of floating drum biogas plants	**07**
		OR	
Q.3	**(a)**	Calculate the ideal power developed by a wind turbine with a rotor diameter of 25 m and velocity of 4 m/s. Find the ideal power if velocity is doubled. Comment on the result.	**03**
	(b)	Explain the following components of wind turbine mentioning its function i) Nacelle ii) Yaw Control Mechanism iii) Pitch Control Mechanism	**04**
	(c)	Classify gasifiers and explain at least one gasifier with a neat sketch	**07**
Q.4	**(a)**	Justify the need for solar energy storage and enlist different energy storage methods	**03**
	(b)	Explain the concept and working principle of MHD	**04**
	(c)	Write a short note on any two wave energy conversion devices.	**07**

OR

Q.4 **(a)** Explain the concept of Evacuated tube collector **03**

(b) Explain hot dry rock geothermal energy. **04**

(c) State the principle of Ocean Thermal Energy Conversion (OTEC). Explain the working of the closed-cycle OTEC system. **07**

Q.5 **(a)** Define: **03**

i) Cumulative Savings
ii) Life cycle savings
iii) Payback period

(b) Explain the working of the Solar Cooker. **04**

(c) A solar hot water system has an array of flat-plate collectors with an area of 50 m^2 installed in a factory. It costs Rs.25000/- and is set up with an initial down payment of 20 % of the investment, the balance of 80 % is taken as a soft loan to be repaid in equal installments over 5 years at an interest rate of 5%. The cost of conventional fuel saved in the 1^{st} year is Rs 50000 and this cost increases with a rate of 5 % every year. The annual expenditure required is Rs20000/- in the 1^{st} year and this expense increases by 5% every year. Tax deductions are permissible only on depreciation, which is allowed at the rate of 25 % each year, and the company tax rate is 30%. Assuming that the cost of an equivalent conventional energy system is Rs 25000 and that the market discount rate is 10 %. Calculate the CS over 15 years. Also, calculate the payback period with and without discounting. **07**

OR

Q.5 **(a)** Calculate the annual cost of a solar energy system with the characteristics tabulated below. **03**

Factor	Specification
Expected system lifetime t (Yr.)	20
Discount rate (%)	8
Collector area Ac (m2)	20
Collector cost (Rs/ m2)	100
Storage cost (Rs/ m2)	6.25
Cost of control system (Rs.)	100
Miscellaneous cost (Rs.)	200+(5 Ac)
Capital recovery factor for 20 years at 8 %	0.102

(b) Enlist various approaches to using solar energy for refrigeration and explain any one of them. **04**

(c) Write a short note on clean development mechanisms **07**

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