

CS/B.TECH/ME (NEW)/SEM-7/ME-703 B/2013-14
2013

RENEWABLE ENERGY SYSTEMS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP - A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

$$10 \times 1 = 10$$

- i) An MPPT is basically
 - a) a dc-dc switching regulator
 - b) an ac-dc converter
 - c) a dc-ac inverter
 - d) an amplifier.
- ii) The range of wind speed suitable for wind power generator is
 - a) 0 to 5 m/s
 - b) 5 m/s to 25 m/s
 - c) 25 m/s to 50 m/s
 - d) 50 m/s to 75 m/s.

- iii) Biogas is predominantly
 - a) hydrogen
 - b) carbon monoxide
 - c) carbon dioxide
 - d) methane.
- iv) The turbine used in a tidal range plant is a
 - a) pelton turbine
 - b) kaplan turbine variable pitch blades
 - c) kaplan turbine fixed pitch blades
 - d) francis turbine.
- v) Wave energy is basically harnessed in the form of
 - a) thermal energy
 - b) chemical energy
 - c) mechanical energy
 - d) electrical energy.
- vi) For a reversible adiabatic process, the change in entropy is
 - a) zero
 - b) minimum
 - c) infinite
 - d) unity.
- vii) A wind turbine extracts maximum power from wind, when the downstream wind speed reduces to
 - a) One third of the upstream wind
 - b) Half of the upstream wind
 - c) Two-third of the upstream wind
 - d) Zero.

viii) One tidal cycle takes about

- a) 3 hours 6 minutes
- b) 6 hours 12 minutes
- c) 12 hours 24 minutes
- d) 24 hours 48 minutes.

ix) The energy storage is required primarily

- a) to conserve energy
- b) to meet the energy demand of future generations
- c) to match the energy supply and demand
- d) to reduce energy consumption.

x) OCET characteristic is having

- a) high efficiency low installation cost
- b) low efficiency high installation cost
- c) low efficiency low installation cost
- d) high efficiency high installation cost.

GROUP - B

(Short Answer Type Questions)

Answer any three of the following.

$3 \times 5 = 15$

2. A deep ocean wave of 2m peak to peak appears at a period of 8 sec. Find the wavelength, phase velocity and power associated with the wave. At this power rate, what is the average annual wave energy in MWh/m.
3. Explain in brief the principle of P-V power generation.

Band gap energy of GaAs is 1.43 eV. Calculate the optimum wavelength of light for photovoltaic generation in a GaAs cell.

$3 + 2$

4. Mention the different types of geothermal resources and indicate which one can be commercially utilized.

With a simple sketch explain how a liquid dominated geothermal resource can be used for power generation indicating the thermodynamic cycle followed.

$2 + 3$

5. What are the advantages and disadvantages of biomass energy ?

6. Discuss the working of a solar salt pond.

GROUP - C**(Long Answer Type Questions)**

Answer any three of the following. $3 \times 15 = 45$

7. a) Explain current-voltage characteristics of a solar cell and define fill factor.
- b) Estimate the monthly average of the daily global radiation on a horizontal surface at Agra ($27^{\circ}10' N$, $78^{\circ}05' E$) during the month of January, if the average sun shine hour per day is 7 h. $6 + 9$
8. a) Mention the parameters on which the energy potential of a wind stream facing a wind turbine depends.
Derive an expression for wind power extraction by a wind turbine. Hence show also the maximum theoretical power generation possible and the necessary condition.
- b) Discuss power vs wind speed characteristics for different turbine diameters with the help of a diagram.
- c) Wind at standard atmospheric pressure and $15^{\circ}C$ flowing with a velocity of 15 meter/sec flows through a wind turbine of diameter 120 metre running at 40 RPM. Calculate : i) Wind potential power density, ii) Maximum theoretical power extractable, iii) A reasonably obtainable power output, iv) Torque developed. $7 + 3 + 5$

9. a) With a simple line diagram show how solar PV cell can be used to supply electric power to utility or grid.
What is I-V characteristics of a PV cell and how the characteristics change for different solar intensity ?
What is an MPPT unit ?
- b) A P-V cell supplies power to a load of 10 volt, 8 Amp. The maximum power point is 25 volt, 6 Amp. Calculate additional power gained by using a MPPT of 92% efficiency. Solar intensity at the place is 740 W/m^2 . If the P-V cell covers an area of 1 m^2 calculate the conversion efficiency of the cell when an MPPT is used.
- c) Explain the function of a wave power generating system using air turbine as the power generator. $7 + 4 + 4$
10. a) What is the basic principle of tidal power ? Explain single basin, single effect tidal energy conversion scheme.
- b) A single basin type tidal power plant has a basin area of 2 km^2 . The tide has an average range of 13 m. Power is generated only during the ebb cycle. The turbine stops operating when the head on it falls below 3 m. Calculate the average power generated by the plant in single emptying process of the basin if the turbine generator efficiency is 0.7. Estimate the average annual energy generation of the plant.
- c) Write down the limitations of tidal power schemes. $6 + 5 + 4$

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11. What is meant by geo-thermal energy ? By what methods this energy is extracted ? What are the difficulties and disadvantages of a geo-thermal generation ? What are the possible sources of geo-thermal pollution ? How are these avoided ?

2 + 2 + 4 + 4 + 3
