

SAMURAI – Comprehensive Short Answers Q&A;  
(Sustainable Energy Technologies – All Units)

UNIT 1 – SOLAR RADIATION

1. Define renewable energy.

Ans: Energy from natural sources that replenish naturally, such as solar and wind.

2. What is the role of renewable energy today?

Ans: Reduces pollution, increases sustainability, and decreases fossil fuel dependence.

3. What is the structure of the Sun?

Ans: Consists of core, radiative zone, convective zone, photosphere, chromosphere and corona.

4. Define solar constant.

Ans: Solar radiation incident outside Earth's atmosphere, approx.  $1367 \text{ W/m}^2$ .

5. What are sun–earth relationships?

Ans: Describe how Earth's tilt and orbit affect solar radiation received.

6. What is solar altitude angle?

Ans: Angle between sun's rays and horizontal plane.

7. What is declination angle?

Ans: Angle between the equator and the line joining Earth's center and Sun.

8. Define beam and diffuse radiation.

Ans: Beam travels in a straight line; diffuse is scattered in the atmosphere.

9. What is global radiation?

Ans: Sum of beam and diffuse radiation on a horizontal surface.

10. What is a pyranometer?

Ans: Measures global solar radiation.

11. What is a sunshine recorder?

Ans: Measures sunshine duration.

12. What is extraterrestrial radiation?

Ans: Solar radiation received outside Earth's atmosphere.

13. What is terrestrial radiation?

Ans: Solar radiation after passing through Earth's atmosphere.

14. What is tilted surface radiation?

Ans: Total radiation incident on a surface inclined at an angle.

UNIT 2 – SOLAR PV MODULES & SYSTEMS

1. What is a PV cell?

Ans: A semiconductor device converting sunlight into electricity.

2. Define module packing density.

Ans: Ratio of solar cell area to total module area.

3. What causes mismatch losses?

Ans: Variations in cell characteristics within a module/string.

4. What is module degradation?

Ans: Loss of output over time due to material and environmental effects.

5. What are PV module parameters?

Ans: Voc, Isc, FF, efficiency and maximum power point.

6. What is fill factor?

Ans: Ratio of max power to product of Voc and Isc.

7. What is a PV array?

Ans: A set of modules connected electrically.

8. What is battery depth of discharge?

Ans: Percentage of battery capacity that is discharged before recharging.

9. Types of batteries used in PV systems?

Ans: Lead-acid, lithium-ion, Ni-MH, gel batteries.

10. Define charge controller.

Ans: Regulates battery charging and prevents overcharging.

11. What affects PV module efficiency?

Ans: Temperature, dust, shading, and angle of incidence.

12. What is temperature coefficient?

Ans: Indicates how module performance varies with temperature.

13. What are interconnections in PV modules?

Ans: Series and parallel connections of cells to achieve desired voltage/current.

### UNIT 3 – SOLAR COLLECTION, STORAGE & APPLICATIONS

1. Define flat plate collector.

Ans: Simple non-concentrating device absorbing solar heat at low-to-medium temperatures.

2. What are concentrating collectors?

Ans: Devices using optical components to focus sunlight on a smaller area.

3. What is absorber plate?

Ans: Component that absorbs incoming solar energy.

4. Define latent heat storage.

Ans: Storage of energy during phase change.

5. Define sensible heat storage.

Ans: Heat stored by raising temperature of a material.

6. What is a solar pond?

Ans: Salinity-gradient pond for heat storage.

7. What is solar distillation?

Ans: Purification of water using solar heat.

8. What is solar cooking?

Ans: Use of solar energy for cooking via reflectors or box-type cookers.

9. What is central tower receiver system?

Ans: Concentrated solar power system using heliostats and a tower-mounted receiver.

10. What is stratified storage?

Ans: Storage with layers at different temperatures.

11. What is solar drying?

Ans: Removal of moisture using solar heat.

12. What is solar chimney?

Ans: System that generates electricity using air heated by solar radiation.

#### UNIT 4 – WIND ENERGY & BIOMASS

1. What is wind energy?

Ans: Kinetic energy of wind converted into mechanical or electrical energy.

2. What is Betz limit?

Ans: Max theoretical efficiency of wind turbine is 59.3%.

3. Difference between HAWT and VAWT?

Ans: HAWT has horizontal axis rotation; VAWT rotates on a vertical axis.

4. What are wind characteristics?

Ans: Speed, direction, turbulence, density.

5. What is cut-in wind speed?

Ans: Minimum speed at which turbine starts generating power.

6. What is cut-out speed?

Ans: Speed at which turbine stops for safety.

7. What is anaerobic digestion?

Ans: Breakdown of biomass without oxygen to produce biogas.

8. Types of biogas digesters?

Ans: Floating drum, fixed dome, balloon type.

9. What is gasification?

Ans: Conversion of biomass into producer gas through partial combustion.

10. What affects biogas yield?

Ans: Feedstock type, temperature, retention time.

## UNIT 5 – GEOTHERMAL, OCEAN ENERGY & FUEL CELLS

1. What is geothermal energy?

Ans: Heat from Earth's interior used for electricity/heating.

2. Types of geothermal resources?

Ans: Hydrothermal, hot dry rock, geopressured, magma.

3. What is OTEC?

Ans: Ocean Thermal Energy Conversion uses temperature gradients.

4. Types of OTEC cycles?

Ans: Open, closed, hybrid cycles.

5. What are environmental impacts of OTEC?

Ans: Marine disturbance, water discharge issues.

6. Define fuel cell.

Ans: Electrochemical device converting chemical energy into electricity.

7. Types of fuel cells?

Ans: PAFC, AFC, PEMFC, MCFC, SOFC.

8. What is a PEM fuel cell?

Ans: Uses proton exchange membrane for high-efficiency hydrogen conversion.

9. What is MCFC?

Ans: Molten Carbonate Fuel Cell operating at high temperature.

10. Advantages of fuel cells?

Ans: High efficiency, low emissions, noiseless operation.