(3 Hours) **[Total Marks: 80]**

N.B.

1. **Question No.1 is Compulsory**
2. Answer any three out of remaining five questions
3. Assume any suitable data wherever required, justify the same
4. Illustrate answer with sketches wherever required

Q.1 a)	State and compare various renewable energy sources. What is the possibility of mitigating the problem faced due to fossil fuels with the integration of renewable energy?	**05**
b)	List out the solar PV technologies. Illustrate anyone in brief.	**05**
c)	Describe the working principle of a tidal energy power generation	**05**
d)	What are the different ways to use solar thermal energy? Describe any one of them in brief with the help of neat diagram.	**05**
Q.2 a)	Describe the principle of operation of Proton Exchange Membrane Fuel Cell (PEMFC) along with its electrical characteristics. Illustrate how PEMFC can fed power to three phase AC standalone load.	**10**
b)	Illustrate the financial benefits of energy storage systems in detail.	**10**
Q.3 a)	Explain the following technologies: i) Wave energy ii) Pumped hydro storage system	**10**
b)	Illustrate the concept of Maximum power point tracking (MPPT) in solar PV system? Illustrate the P&O MPPT algorithm. What precautions should be taken when using MPPT system?	**10**
Q.4 a)	Draw I-V (current v/s voltage) and P-V (power v/s voltage) characteristics of a solar PV cell and clearly mark all essential parameters on it. What is the impact of change in solar radiation and temperature on solar PV characteristics?	**10**
b)	Explain the working of a Wind Energy System (WES) with its various components. What are the different power converter topologies used for WES? Explain anyone in detail.	**10**
Q.5 a)	State and explain following parameters related to batteries: i) State of charge (SOC) ii) Depth of discharge (DOD) iii) Battery Capacity iv) C-Rating	**10**
b)	Illustrate the principle of Aerodynamics in relation with Wind turbine operation	**05**
c)	Illustrate the phenomenon of Hot Spots in PV module.	**05**
Q 6	Write short notes on: a) Solid Oxide Fuel Cell b) Distributed Generation c) Necessity of energy storage for PV system d) Electric Vehicle operation	**20**