(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)	Discuss two power quality issues and two protection issues of the solar PV system	**05**
	b)	List out the solar PV technologies. Illustrate anyone in brief.	**05**
	c)	Compare Horizontal Axis Wind Technology and Vertical Axis Wind Turbine	**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 principle of pumped hydro storage system and their importance	**10**
	b)	Draw the power topology of wind energy system based on doubly fed induction generator	**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) Compare various solar PV technology Mono crystalline, poly crystalline and thin film (08) b) Flywheel as an energy storage device c) What is MPPT in solar system? Explain anyone MPPT algorithm. Also explain distributed MPPT	**08** **05** **07**