(3 Hours) [Total Marks: 80]

N.B.: 1. **Q.1 is compulsory**
2. Answer **any Three** out of remaining **Five** questions
3. Assume any suitable data wherever required but justify the same
4. Use graph paper wherever necessary

Q1 (A) Draw I-V (current v/s voltage) and P-V (power and voltage) characteristics of a solar 05
PV panel at standard test conditions (STC). Clearly mark all essential parameters on
the characteristics. Also show the impact of change in solar radiation (reduce to70%
of STC) and operating temperature on its characteristics.

(B) Draw the wind turbine characteristics. Explain the features of horizontal axis wind 05
turbine and vertical axis wind turbine.

(C) Explain the principles of Tidal and Wave Energy systems and their potential for 05
electricity generation in India.

(D) Illustrate the importance and role of renewable energy and energy storage systems in 05
electrical power system. What are the types of alternative energy generation adopted
by India? State their generation capacities.

Q.2 (A) Describe how partial shading impacts the performance of a solar PV system? Describe 08
the means and ways to minimize the effect of partial shading?

(B) Illustrate the working principle of a Fuel cell with the help of its construction details 06
and characteristics. State the different types of Fuel cells used in power generation.

(C) Compare the performance of Solar PV, Fuel cell and WES as the renewable energy 06
sources.

Q.3 (A) Illustrate a typical single-phase AC stand-alone hybrid power generation system 08
comprising solar PV source combined with fuel cell and ultra-capacitor bank.
Determine the power capacity you would propose for each one of the sources if the net
capacity of system is 10 kW and justify the same. Make necessary assumptions if
needed. Explain role of each source in the system operation.

(B) Draw the schematic of the following: 12
(i) Power topology of a single-phase AC standalone solar PV system.
(ii) Power topology of a solar PV battery charging system for dc applications
(iii) Power topology of a Fuel cell fed three phase grid tied system

Q.4 (A) Compare the performance of flywheel, battery and ultra-capacitor as the energy storage 06
components. State one application of each in existing energy scenario.

(B) State and explain the following parameters of the batteries: SOC, DOD, C-rate and 08
Energy efficiency.

(C) Explain any one of the Maximum Power Point Tracking (MPPT) algorithm used in 06
Solar PV system.

Q.5 (A) Assume any suitable electrical daily load profile for any particular application. If a **10** hybrid stand-alone system comprising solar PV and battery need to be used to provide the electrical supply to this assumed load, explain the selection and sizing of the solar PV panels and batteries.

(B) Explain the principle of electrical power generation using biomass. **10**

Q.6 (A) Describe the role and importance of renewable energy and energy storage components **10** in Smart-grid and Electric Vehicle applications.

(B) Describe the electrical power generation with following technology in brief: **10**
  (i) Ocean thermal energy system
  (ii) Pumped hydro storage system

****