

(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 necessary and justify the same
4. Illustrate answer with sketches wherever required.

- |     |   |   |    |
|-----|---|---|----|
| Q 1 | a | State and explain the important parameters of the battery: SOC, DOD, Ahr, C-rate and Energy efficiency.   | 08 |
|     | b | Compare the performance of Solar PV, Fuel cell and WES as the renewable energy sources. Explain any one application of each in brief.   | 06 |
|     | c | State and compare different types of solar photovoltaic (PV) cell technology.   | 06 |
| Q 2 | a | Describe the working principle of Proton Exchange Membrane Fuel Cell (PEMFC) and explain its electrical characteristics. Explain the working of a PEMFC fed power converter topology that can be used to feed a single phase standalone load.                           | 10 |
|     | b | Describe various types or forms of energy storage which are commonly used in renewable energy system and compare their performance. What type of energy storage is suitable for hybrid combination with (i) solar PV source (ii) Fuel cell source? Justify your answer. | 10 |
| Q 3 | a | Explain the principles of <b>any two</b> of the following power generation systems.<br>i) Wave energy      ii) Biomass energy      iii) Solar Thermal   | 10 |
|     | b | Explain the principle of Ocean-thermal energy conversion. Write its advantage and disadvantage.   | 10 |
| Q 4 | a | Describe the principles of pumped hydro storage and flywheels used in power systems for long time and transient backup requirements.  | 08 |
|     | b | Draw a typical schematic of AC power topology used to extract power from solar PV and explain the operation in standalone mode and grid connected mode. Also explain the closed loop control scheme to be used for both the operating modes.                            | 12 |
| Q 5 | a | What are the various components of Wind Energy System (WES). Describe each one in brief. Explain any one of the power converter topologies used for WES.  | 12 |
|     | b | State and explain the importance of energy storage in stability enhancement under large penetration of renewable energy sources in existing power system?   | 08 |
| Q 6 | a | Explain the role of renewable energy and energy storage systems (REES) in electric vehicles and smart grid scenario.  | 12 |
|     | b | Draw a typical schematic of power topology used to extract maximum power from Solar PV panels and explain its operation in grid connected mode.   | 08 |

\*\*\*\*\*