Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 13915

M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Elective

Power Systems Engineering

PS 7004 — SOLAR AND ENERGY STORAGE SYSTEMS

(Common for M.E. Power Electronics and Drives and M.E. Electrical Drives and Embedded Control)

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define clearness index.

2. Write the equation of fill factor for the ideal case.

3. Draw the equivalent circuit of the Lead acid battery.

4. What do you meant by RAM batteries?

5. What is capacity credit?

6. List the module mounting approaches.

7. Comparison of PSCO and ERCOT systems.

8. What is the loss of high-rate discharge capacity?

9. List the solar energy based direct drive applications.

10. What are the methods of solar thermal energy storage?

PART B — (5 × 16 = 80 marks)

11. (a) (i) The absorption coefficient of silicon decreases from $1.65 \times 10^6 cm^{-1}$ at 0.3 μm wavelength, to 4400 cm^{-1} at 0.6 μm and 3.5 cm^{-1} at 1.1 μm. Assuming zero reflection from both front and rear surfaces at each wavelength, calculate and sketch the generation rate of electron-hole pairs, normalised to the surface generation rate, across a silicon cell of 300 μm thickness. (8)

(ii) Explain the effect of parasitic series and shunt resistances in a solar circuit. (8)

Or

(b) (i) Discuss the degradation and failure modes of a solar module. (8)

(ii) When the cell temperature is 300 K. a certain silicon cell of 100 cm^2 area has an open circuit voltage of 600 mV and a short circuit current of 3.3 A under 1 kW/m^2 illumination. Assuming that the cell behaves ideally, what is its energy conversion efficiency at the maximum power point? (8)

12. (a) (i) Explain the mathematical modeling of a PV system. (8)

(ii) Discuss the parameters when select an inverter for a particular application. (8)

Or

(b) Design a standalone PV system for your home having 10 kW load. (16)

13. (a) Discuss the design issues in the grid connected PV system. (16)

Or

(b) (i) Write notes on islanding. (8)

(ii) Explain the possible placement of a PV station in a grid prone to thermal overload. (8)

14. (a) Explain the design of cylindrical storage tank and its properties. (16)

Or

(b) (i) Explain the impact of emission impacts on plant generation. (8)

(ii) How can design the size of a penstock for a Francis turbine? (8)

15. (a) Design a solar water pump with the consideration of the following:

(i) Calculate the water pumping load and pumping rate

(ii) Calculate current

(iii) Calculate system array size

(iv) Design the controller

(v) Select switching and protection components

(vi) Design DC wire size. (16)

Or

(b) Design the following for a solar car

(i) Drive

(ii) PV array size

(iii) Controller

(iv) Battery

(v) Protection components. (16)