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**Question Paper Code : X86866**

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2021  
Second Semester  
Power Systems Engineering  
PS5092 – SOLAR AND ENERGY STORAGE SYSTEMS  
(Regulations 2017)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A

(10×2=20 Marks)

1. Define insolation.
2. How to reduce the optical losses in a solar cell ?
3. What are parameters required to determine the load ?
4. Draw the block diagram of standalone PV system.
5. Compare central inverter and string inverter.
6. What is Grid islanding in PV systems ?
7. What are the advantages of pumped hydroelectric energy storage ?
8. What are the factors to be considered while designing a solar storage system ?
9. How photovoltaics is used in telecommunication ?
10. State the significance of solar car.



PART – B

**(5×13=65 Marks)**

11. a) Draw and obtain the equivalent circuit and I-V characteristics of PV cell.

(OR)

b) i) Briefly explain the bond and band model. **(7)**

ii) Explain about the extraterrestrial and terrestrial radiation falling on horizontal surface. **(6)**

12. a) Design a stand-alone PV system with DC load using MPPT.

(OR)

b) Explain in detail how the charge equalization can be performed :

i) When batteries are connected in series. **(6)**

ii) When batteries are connected in parallel. **(7)**

13. a) Discuss in detail about the various design issues involved in the design of central power station.

(OR)

b) Explain about any three international PV program in existence and its development.

14. a) Explain in detail about solar thermal energy storage system.

(OR)

b) Discuss in detail about the charge and discharge cycles of typical Li-ion battery with its diagram and explain briefly about Thermal run away, capacity fading and loss of high-rate discharge.

15. a) Explain in detail with necessary diagram, the principle of operation of solar photovoltaic based direct drive application and battery charger.

(OR)

b) Explain the working principle of water pumping and also obtain the expression for solar power.



PART – C

**(1×15=15 Marks)**

16. a) Design a solar PV system where the load consists of a CFL, TV, fan, Refrigerator and computer. The system should allow the use of loads in the non-sunshine hours. The operating hours and the power rating of these loads are given below.

S. no.	Load	Numbers	Watts	Hours/day	Watt-hr. (Wh)
1	CFL	2	9(each)	5	90
2	Fan	1	60	8	480
3	TV	1	150	2	300
4	Refrigerator	1	150	8	1200
5	Computer	1	250	3	750

(OR)

- b) i) A PV panel having an area of  $3.5\text{m}^2$ , gives the following readings under standard test conditions. The short circuit current is 6A, the open circuit voltage is 40V, the voltage at peak power is 36.5 V and the current at peak power is 10A. The fill factor of the PV panel is found to be 0.72. Calculate the efficiency of the panel. **(5)**
- ii) Consider a 1000 watts solar panel array that operates a 48 V DC and battery bank at 24 volts DC. Choose the MPPT charge controller ratings for this system. **(5)**
- iii) A solar cell has the following parameters.  $V_{oc} = 0.6\text{V}$ ,  $I_{sc} = 30\text{ mA/cm}^2$  and fill factor = 76%. Calculate the cell efficiency. **(5)**
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