MASTER OF TECHNOLOGY IN ENERGY SCIENCE &

TECHNOLOGY EXAMINATION, 2024 (2nd Semester)

Photovoltaic Energy Systems

Time: Three hours   Full Marks: 100

Use a separate Answer- Script for each part

PART-I (60 marks)

Answer *any three* from the following questions.   [20X3 = 60]

1. (a) Explain operating principle with its figure of merits of Solar PV cells.

   (b) Using the simple design method, design a PV system using 90 W, 12 V panels and 150Ah, 12 V batteries. The PV system is required to offer 2 days of storage, the battery efficiency is 70%, and the depth of discharge is 70%. The location where the system is located has 5 h of daylight during wintertime and the application is 24 V with a load of 1000 Wh.

   (c) With block diagram show the series and parallel connection of modules in a panel. Also explain the function of bypass diode connected with the panel.

[6 + 8 + 6]

2. (a) What are different application of Solar PV Module? Explain different balance of the system (BOS) for a Stand Alone SPV Power System.

   (b) With the neat sketch explain the principle of Series Regulation of a stand-alone SPV system.

   Also explain its merit and demerits.

   (c) With neat sketch explain the different components of a Grid interactive SPV power plant.

   How it helps to improve the grid power quality?

[(2+4) + (5+2) + (4+3)]

3. (a) State the different performance testing methods of SPV modules.

   (b) Explain the methods of performance test of SPV modules/panels in NOCT and STC

      Conditions.

   (c) Explain different storage system for SPV power plant.

[5 + 10 + 5]

4. Write short notes on the followings:

   (a) Distributed power system

   (b) Thin Film Solar Cell Technology

   (c) Different losses in a solar cell

   (d) Monitoring and Maintenance of SPV system

[5 X 4 = 20]

Ref. No.: Ex/PG/EST/T/128A/2024(O)

M.TECH. ENERGY SCIENCE AND TECHNOLOGY FIRST YEAR SECOND SEMESTER EXAM-2024

Subject: PHOTOVOLTAIC ENERGY SYSTEMS

Time: 3 Hours (Part-I+II)   Full Marks: 40

Part-II

Instructions: Use a Separate Answer script and Answer any two questions.

1. Why silicon (Si) is used for the development of PV cells? Explain the process technology of silicon based solar cells. Write about the differences between crystalline and amorphous material regarding PV cells. What do you mean by energy payback period?

[20]

2. What are the necessities of PV module? Explain the production methodology regarding the development of PV module. What do you mean by cell mismatch loss in a module? Write about the differences between photovoltaic and photoconductive phenomenon.

[20]

3. Design a PV system to pump water for livestock in Bankura, West Bengal. The following information is given below

Site	:	23.2313° N, 87.0784° E
Ambient temperature	:	30°C to 45°C
Static head	:	110 m
Maximum drawdown	:	15 m
Water required		8500 L/day, June to August

Daily solar radiation	:	April	11.55 kWh/m²·day
		May	10.58 kWh/m²·day
		Jun	10.05 kWh/m²·day

Here, used to design a 75-V DC jack pump with an average efficiency of 0.45. Frictional head loss in the pipe is 0.05 (friction factor). For this design, please utilize PV panels with the following specifications

Voltage	$V_{oc} = 21.7$ V	V_m at 25° = 17.4 V
Current	$I_s = 3.5$ A	$I_{L,m} = 3.1$ A

Temperature correction factor for voltage $= 1 - 0.0031 \ (T_c - T_{ref})$
Maximum panels temperature rise 20°C

[20]

[Turn over

2. Write a short note the following question (any four)

   (a) DC to DC Converters

   (b) Super Capacitors

   (c) Grid Integration of PV Systems

   (d) Solar simulator

   (e) Photovoltaic (PV) Inverter

[5×4=20]

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