Course Code: 18EE0236 **R18**

SIDDARTHA INSTITUTE OF ENGINEERING AND TECHNOLOGY:: PUTTUR
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QUESTION BANK (DESCRIPTIVE)

Subject with Code: Solar Photovoltaic Systems (18EE0236) **Course**: Open Elective-II

Year & Sem: IV-B.Tech & I-Sem **Regulation:** R18

UNIT-I
INTRODUCTION

1.	(a) Define Air mass.	[L1] [CO1] [2M]
	(b) Define Irradiance and its unit.	[L1] [CO1] [2M]
	(c) Define Irradiation and its unit.	[L1] [CO1] [2M]
	(d) Define Solar constant and what is the value of solar constant	[L1] [CO1] [2M]
	(e) Define Standard solar radiation,	[L1] [CO1] [2M]
2.	(a) Define conventional and non-conventional Energy with Examples.	[L2] [CO1] [5M]
	(b) Outline the merits and demerits of Non-Conventional energy sources?	[L1] [CO1] [5M]
3.	What are the different renewable energy resources available in the world? Explain	[L3] [CO1] [10M]
4.	Describe Solar Energy Scenario in India and Andhra Pradesh.	[L2] [CO1] [10M]
5.	(a) Explain in brief about solar energy.	[L2] [CO1] [5M]
	(b) Outline the challenges and remedies associated in the use of solar energy.	[L2] [CO1] [5M]
6.	(a) Discuss about Extraterrestrial and Terrestrial solar radiation.	[L3] [CO1] [5M]
	(b) Discuss about the Solar radiation components segregated by the atmosphere and surface	[L3] [CO1] [5M]
7.	(a) What are the types of solar radiation measuring Instruments? (b) What are the Radiometer Uncertainty Sources?	[L2] [CO1] [5M] [L3] [CO1] [5M]
8.	Explain the working principle of Pyrheliometer and Pyranometer with a neat sketch.	[L2] [CO1] [10M]
9.	(a) Consider the earth to be a blackbody with average surface temperature 15◦C and area equal to 5.1×10^{14} m^2. Find the rate at which energy is radiated by the earth and the wavelength at which maximum power is radiated. Compare this peak wavelength with that for a 5800 K blackbody (the sun).	[L4] [CO1] [5M]
	(b) At solar noon in latitude 33.7◦ on May 21 the altitude angle of the sun was found to be 76.4◦ and the clear-sky beam insolation was found to be 902 W/m^2. Find the beam insolation at that time on a collector that faces 20◦ toward the southeast if it is tipped up at a 52◦ angle.	[L3] [CO1] [5M]
10.	Discuss about • Fixed PV systems; • Single-axis tracking PV systems; • Dual-axis tracking PV systems.	[L2] [CO1] [10M]

UNIT-II
PV CELLS AND MODULE

1.	(a) What is solar cell?	[L1] [CO2] [2M]
	(b) What is a solar PV module?	[L1] [CO2] [2M]
	(c) What is the rating of PV module?	[L1] [CO2] [2M]
	(d) Define the short circuit current of the PV module?	[L1] [CO2] [2M]
	(e) What is Fill Factor?	[L1] [CO2] [2M]
2.	(a) Explain how solar photovoltaic cell generates electricity in detail.	[L4] [CO2] [5M]
	(b) What are the different Solar cell technologies	[L2] [CO1] [5M]
3.	Explain all the parameters of solar cells.	[L4] [CO2] [10M]
4.	(a) A solar cell having an area of 100 cm^2 gives 3.1 A current at maximum power point and 0.5 V at maximum power point at STC. The cell gives 3.5 A short circuit current and 0.6 V open circuit voltage. What is the maximum power point of the solar cell? Also find out the efficiency of the cell.	[L3] [CO2] [5M]
	(b) A solar cell having an area of 25 cm^2 gives 0.85 A current at maximum power point and 0.55 V at maximum power point at STC. The cell gives 0.9 A short circuit current and 0.65 V open circuit voltage. What is the maximum power point; fill factor and efficiency of the solar cell?	[L4] [CO2] [5M]
5.	(a) A solar cell having Fill factor (FF) 68% gives 0.6 V at maximum power point at STC. The cell gives 3 A short circuit current and 0.7 V open circuit voltage. What is the current at maximum power point of the solar cell?	[L4] [CO2] [5M]
	(b) A solar cell has maximum power point of 0.3 W. The cell voltage at maximum power point at STC is 0.65 V. What is the current at maximum power point of the solar cell?	[L2] [CO2] [5M]
6.	Discuss all the factors affecting electricity generated by a solar cell.	[L3] [CO2] [10M]
7.	(a) Calculate the output power from a solar cell if its efficiency (in %) is 30, 24, 19, 16, 12, input power density is 1000 W/m^2, and area of the solar cell is 100 cm^2.	[L4] [CO3] [5M]
	(a) Calculate new value output current for solar cells of area 20, 30, 50, 80 and 100 cm^2, when current density of cell is 3 mA/cm^2.	[L3] [CO3] [5M]
8.	What are the different Standard PV module parameters? Discuss all of the parameters.	[L2] [CO2] [10M]
9.	Discuss all the factors affecting electricity generated by a solar PV module.	[L3] [CO3] [10M]
10.	(a) What are the different Measuring Parameters of the PV module? Give a brief idea about this.	[L2] [CO3] [5M]
	(b) Design a Solar PV module for providing Voltage at maximum power point of V_m 30 V (STC) and 28.5 V (under operating conditions, 55 ^{0}C cell temperature). Use the cells with open circuit voltage of 0.62 V and 0.002 V decrease in V_m per degree centigrade rise in temperature.	[L4] [CO3] [5M]

UNIT-III
SOLAR PHOTOVOLTAIC MODULE ARRAY

1.	(a) What is BYPASS diode?	[L1] [CO3] [2M]
	(b) What is BLOCKING Diode?	[L1] [CO3] [2M]
	(c) What is the PV module string?	[L1] [CO3] [2M]
	(d) What is PV module array?	[L1] [CO3] [2M]
	(e) Draw two PV modules with V_{oc} = 18V and V_{oc} = 12. Connect them in series and find the total V_{oc} of the series circuit.	[L1] [CO3] [2M]
2.	Give the stepwise process of estimating number of PV modules required in series connection and their power calculation.	[L2] [CO3] [10M]
3.	Calculate the number of modules to be connected in series to obtain maximum power point voltage of 70 V. The modules available for connection are having following parameters. V_{oc} = 20 V, V_m = 15 V, I_{sc} = 5 A and I_m = 3.5 A	[L4] [CO3] [10M]
4.	In a PV power plant of 1 MW capacity, a large number of PV modules are connected in series. In such plants, 1 MW inverter can take input voltage in range of 600 V to 800 V. Design the number of PV modules to be connected in a single series (PV module string) to obtain voltage at maximum power point of 700 V. Also, estimate the peak power that will be supplied by one such PV module string. The parameters of PV modules to be used are: V_{oc} = 36 V, V_m = 30 V, I_{sc} = 8.2 A and I_m = 7.4A	[L5] [CO3] [10M]
5.	Give the stepwise process of estimating number of PV modules required in parallel connection and their power calculation.	[L2] [CO3] [10M]
6.	Estimate the number of SPV modules to be connected in parallel to achieve the current at peak power point of 42 A. The system voltage requirement is 16 volts. The modules to be connected are having parameters V_m = 16 V, I_m = 7 A, V_{oc} = 20 V, I_{sc} = 8.5 A.	[L4] [CO3] [10M]
7.	Estimate the number of modules required to fulfill the maximum power point current of 96 A, with maximum voltage of 35 V. The modules available are having the following parameters: V_{oc} = 40 V, V_m = 36 V, I_{sc} = 8.5 A, I_m = 7.5 A Also, find out the total power of the plant designed.	[L4] [CO3] [10M]
8.	Give the stepwise process of estimating number of PV modules required in series and parallel connection and their power calculation.	[L2] [CO3] [10M]
9.	Estimate the number of PV modules to be connected together in order to design a solar PV system for power generation with following requirements: Power = 10 kW, Voltage at peak power = 200 V, Current at peak power = 50 A, The PV modules available for this plant are having the following parameters: V_m = 35 V, I_m = 8.5 A. Recalculate the numbers. After calculation of number of PV modules, estimate the actual peak power of the system.	[L5] [CO3] [10M]
10.	In a PV power plant of 1 MW capacity, a large numbers of PV modules are required to be connected in series and parallel combinations. Design number of PV modules to be connected in a series and in parallel for 1 MW, PV plant. In the PV power plant, the desired voltage at maximum power point is 700 V. Estimate the current at peak power point of the plant. Estimate the peak power that will be supplied by one such PV module string. The parameters of PV modules to be used in the PV plant are following: V_{oc} = 44 V, V_m = 32 V, I_{sc} = 8.5 A and I_m = 7.5 A.	[L5] [CO3] [10M]

UNIT-IV
SOLAR PV SYSTEM DESIGN AND INTEGRATION

1.	(a) Draw an Energy flow diagram of a PV system used for system design.	[L1] [CO4] [2M]
	(b) What are the different parameters have to consider before calculate the battery bank size?	[L1] [CO4] [2M]
	(c) What are the different components of Grid connected PV systems?	[L1] [CO4] [2M]
	(d) What is central inverter? Draw a diagram.	[L1] [CO4] [2M]
	(e) What is series string inverter? Draw a diagram.	[L1] [CO4] [2M]
2.	What are the different types of solar PV systems? Draw the schematic diagram of each PV systems.	[L3] [CO2] [10M]
3.	(a) Describe the working principle of standalone SPV system with only AC/DC load, electronics control circuit and battery. (b) Describe the working principle of grid connected SPV system with battery storage.	[L3] [CO4] [5M] [L3] [CO4] [5M]
4.	(a) Describe the working principle of SPV-diesel generator hybrid system (b) Describe the working principle of SPV-wind hybrid system	[L3] [CO4] [5M] [L2] [CO4] [5M]
5.	Find the total number of the PV modules and battery for a house which contains 3 fans of 70 watts each running for 4 hours a day, 3 tubelights of 35 watts each running for 8 hours a day and a refrigerator of 250 watts running for 6 hours a day (consider battery autonomy 1 day). Consider, Inverter Efficiency 93%, system voltage 12 V, Battery DoD = 50%, Battery efficiency = 95%, equivalent daily sunshine hours = 4.5 hours, PV module of 160 W_p. Battery capacity 150 Ah.	[L4] [CO4] [10M]
6.	Find the total number of the PV modules for a factory which contains 1 hp motor (1 hp = 747 W) operating for 4 hours a day, 8 tubelights, each of 50 watts operating for 7 hours a day. Consider a 1 day autonomy for battery. Consider, Inverter Efficiency 93%, system voltage 24 V, Battery DoD = 50%, Battery efficiency = 95%, equivalent daily sunshine hours = 4.5 hours, PV module of 200 Wp. Battery capacity 150 Ah.	[L5] [CO4] [10M]
7.	Describe the design methodology for SPV system.	[L2] [CO4] [10M]
8.	(a) Draw the schematic diagram of solar street lighting system and list out the different components required for the solar street lighting design. (b) Describe the working principle of solar street lighting system.	[L2] [CO4] [5M] [L2] [CO4] [5M]
9.	(a) Draw the schematic diagram of solar lantern system and list out the different components required for the solar lantern design. (b) Describe the working principle of solar lantern system.	[L2] [CO4] [5M] [L2] [CO4] [5M]
10.	(a) What is the function of the charge controller? Write down the features of the charge controller. (b) What is the power converter? Give the classifications of power converter. What is the importance of power converters efficiency?	[L2] [CO4] [5M] [L2] [CO4] [5M]

UNIT-V
SOLAR COLLECTORS AND SOLAR ENERGY STORAGE

1.	(a) List out the technologies used for concentrated solar power generation?	[L1] [CO5] [2M]
	(b) What are the advantages of the thermal energy storage?	[L1] [CO6] [2M]
	(c) What is the thermosiphon effect?	[L1] [CO5] [2M]
	(d) Write down the applications of the thermal energy storage?	[L1] [CO6] [2M]
	(e) Classify thermal energy storage (TES) materials and systems	[L1] [CO6] [2M]
2.	(a) Name the different type of collectors and brief them. (b) Illustrate the working of solar desalination system.	[L2] [CO5] [5M] [L2] [CO5] [5M]
3.	Explain the process of generation of power in solar pond with a neat sketch and also mention its merits and demerits.	[L3] [CO5] [10M]
4.	(a) Illustrate the functions of various components in flat plate collectors. (b) What factors affect the performance of solar flat plate collector?	[L3] [CO5] [5M] [L3] [CO5] [5M]
5.	(a) Describe with a neat sketch working of a solar water heating system. (b) Explain about evacuated tube collectors.	[L2] [CO5] [5M] [L2] [CO5] [5M]
6.	Describe the different concentrated solar power plants for electricity generation.	[L3] [CO5] [10M]
7.	(a) What are the significant benefits of integration of TES in solar thermal systems? (b) What are the requirements should be met by heat storage materials?	[L2] [CO6] [5M] [L2] [CO6] [5M]
8.	(a) What is Storage of sensible heat and the advantages and disadvantages of Storage of sensible heat? (b) Write down the Classification of sensible heat storage concepts with the storage materials name.	[L3] [CO6] [5M] [L3] [CO6] [5M]
9.	(a) What is Storage of latent heat and the advantages and disadvantages of this heat storage? (b) Write down the different materials of latent heat storage and their properties as well as their applications.	[L3] [CO6] [5M] [L3] [CO6] [5M]
10.	(a) What is Storage of chemical heat and the advantages and disadvantages of this heat storage? (b) Write down the Classification of Storage of chemical heat with the storage materials name.	[L3] [CO6] [5M] [L3] [CO6] [5M]

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