Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – Nov/Dec – 2017**

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| **Code :** | **14EE3052** | **Duration :** | **3hrs** |
| **Sub. Name :** | **PV SYSTEM DESIGN AND INSTALLATION** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

**(Datasheet may be allowed)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Elucidate the Photovoltaic (PV) system types with neat diagrams and also describe the Photovoltaic system components. | CO2 | 15 |
| b. | Discuss the importance of matching appliances to the system and if not list down the consequences. | CO2 | 5 |
| (OR) | | | | |
| 2. | a. | Complete the Solar Site Analysis and also discuss the importance of tilt angle for extracting the maximum energy from the solar panel.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Country: India | | | | | | | | | Latitude: 11.35 | | Longitude 77.75 | | | | | | | | **Year** | **Month** | | **Day** | **Hour** | **Minute** | **DHI** | **DNI** | | 2005 | 1 | | 2 | 6 | 30 | 0 | 0 | | 2005 | 1 | | 2 | 7 | 30 | 76 | 222 | | 2005 | 1 | | 2 | 8 | 30 | 126 | 517 | | 2005 | 1 | | 2 | 9 | 30 | 158 | 651 | | 2005 | 1 | | 2 | 10 | 30 | 178 | 725 | | 2005 | 1 | | 2 | 11 | 30 | 188 | 762 | | 2005 | 1 | | 2 | 12 | 30 | 190 | 772 | | 2005 | 1 | | 2 | 13 | 30 | 186 | 756 | | 2005 | 1 | | 2 | 14 | 30 | 174 | 713 | | 2005 | 1 | | 2 | 15 | 30 | 152 | 628 | | 2005 | 1 | | 2 | 16 | 30 | 116 | 472 | | 2005 | 1 | | 2 | 17 | 30 | 55 | 74 | | 2005 | 1 | | 2 | 18 | 30 | 0 | 0 | | CO1 | 10 |
| b. | Design a 48V system with sixteen 12V, 5A PV modules and the battery capacity of 12VDC, 360Ah. Also, find total Volts, total Amps of solar panel and total Amp-Hours of battery. | CO1 | 10 |
| 3. | a. | With P-V graph, explicate the effect of solar radiation and temperature on the Solar Photovoltaic panel. | CO2 | 10 |
|  | b. | With help of simple problem, explain the importance of fill factor and efficiency during shading of photovoltaic modules. | CO2 | 10 |
| (OR) | | | | |
| 4. | a. | A homeowner in a remote mountainous area wants to power the television and refrigerator in his cabin with a photovoltaic system. His refrigerator is a 17-cubic-foot model, rated at 560 watts (240V AC 2.06 amps). He has timed its operation and says it runs 30 minutes each hour (50 percent of the time). The cabin owner’s small television is rated at 20 watts (12V DC, 1.67 amps). At first, he admits to watch only one hour of television per day, but upon further questioning, he realizes his first estimate did not account for an additional hour each day of news, weather and sports. Estimate the homeowner’s load using load estimation worksheet. | CO1 | 8 |
|  | b. | Discuss the factors to be considered when specifying and installing battery storage system for a stand-alone photovoltaic system and elucidate the same. | CO2 | 12 |
| 5. | a. | A client wishes to simultaneously power three 12 volt DC lights (30 watts) and 12 volt DC television (14 watts) using a 12 volt PV array. Three modules wired in parallel are used in the system. Each module has a peak current of 9.25 amps and a short circuit current of 3.28 amps. Calculate the maximum array output amps used to size a controller. Assume, safety factor as 1.25. | CO2 | 15 |
|  | b. | Discuss the factors must be verified for battery less grid-tied inverter. | CO2 | 5 |
| (OR) | | | | |
| 6. | a. | Design a stand-alone PV system for following problem with wiring diagram (Leave Cable Sizing).  A house has the following electrical appliance usage:   1. One 18 Watt fluorescent lamp with electronic ballast used 4 hours per day. 2. One 60 Watt fan used for 2 hours per day. 3. One 75 Watt refrigerator that runs 24 hours per day with compressor run 12 hours and off 12 hours. 4. One 130 Watt TV used for 4 hours per day. 5. One 40 Watt laptop computer used for 8 hours per day.   The system will be powered by 12 VDC, 85 W PV module with 5.02 Peak Amps and Short Circuit Amps as 5.34.  DC System Voltage = 48 V  Battery Depth of Discharge = 50%  Battery Rating = 12 V, 350 Ah Days of autonomy = 3 days (include for all design)  Controller Voltage is 48 Volt.  Maximum pass-through Amperage = 40A  Inverter efficiency = 90%  Continuous Power Output = 4,000A, 48Volt nominal  Surge Capacity 95 Amps.  For other data, assume as per NEC standard. | CO3 | 20 |
| 7. | a. | Calculate the wire sizes needed for the various portions of system and it has following specifications and equipment:  DC system voltage : 24 V  Ten 100 watts modules, each with nominal module voltage of 20 V. The short circuit current (Isc) of each is 7.2 amps and the maximum power current (Imp) of each is 6.2 amps.  Eight batteries, each is 6 V and rated at 350 Ah.  One charge controller that is 24 V and rated for 60 A  One 2500 W inverter with an input DC voltage of 24 V and an output AC voltage of 120 V.  Total connected DC load is 500 W at 24 V.  Voltage drop requirement between the PV and the battery bank is 2% and the distance is 48 feet.  Voltage drop requirement between the battery and DC load is 2% and the distance is 12 feet.  Voltage drop requirement between the battery bank and inverter is 2% and the distance is 7 feet. | CO3 | 10 |
|  | b. | Discuss the importance of equipment grounding and system grounding in PV System Installation. | CO2 | 10 |
| (OR) | | | | |
| 8. | a. | Design a Grid-tied PV system with wiring diagram.  **Size a system for the following home:**  Yearly Average kWh consumption : 3300kWh /Year  Location: Karunya Nagar, TN  Average peak sun shine hours per day : 6 hours  **System Specifications:**  Percentage of power to be generated from PV : 75%  Record low temperature : 22°C  Average high temperature : 38°C  PV module choice: Brand X, Model XYZ  STC rated watts: 170 W  Voc: 30.6 V  Vmax: 24.6 V  Isc: 7.38 A  Imp: 6.93 A  Inverter choice: Brand X, Model XYZ  CEC efficiency: 93.5%  Continuous watt rating: 2,500 W  DC input voltage: 150-450VDC  Assume, PV temperature losses = 0.88, Derate factor = 0.84. | CO3 | 14 |
|  | b. | With neat diagrams, explicate the different types of mounting system in PV installation. | CO2 | 6 |
|  | | **Compulsory**: |  |  |
| 9. | a. | List down the list of materials and tools required on maintenance trip in PV power plant. | CO2 | 5 |
|  | b. | Discuss the final checklist for a newly installed PV system or as a maintenance assessment for an existing PV system. | CO2 | 15 |

ALL THE BEST