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Question Paper Code:U9377

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Open Elective

21UEE977– SOLAR POWER PLANTS

(Regulations 2021)

(Common to All Engineering Branches)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART – A (5 x 20 = 100 Marks)

1. (a) Design a small-scale hydropower plant for a remote area. Consider the available water flow, terrain, and power requirements. Apply the principles of hydroelectric generation to determine the appropriate capacity, turbine type, and generation system. CO2- App (20)
Or
(b) Design a hybrid nuclear power plant system integrated with renewable energy sources. Apply energy management principles to optimize power generation and grid stability. CO2- App (20)
2. (a) Explain the working principle of the Carnot cycle. Describe the four distinct processes involved and their significance in achieving maximum efficiency in a heat engine. CO1- U (20)
Or
(b) Explain the working principle of the Otto cycle. Describe the four processes involved and their significance in converting heat energy into mechanical work. CO1- U (20)
3. (a) Design a solar water heating system using a flat plate collector for a residential building. Apply the principles of heat transfer to select appropriate materials, collector size and orientation to optimize system performance. CO3- App (20)
Or
(b) Design a solar energy collection system using Compound Parabolic Receivers (CPRs) for a residential application. Apply the principles of optics and thermal energy conversion to optimize the efficiency of the system. CO3- App (20)

4. (a) Examine the key differences between Stand-Alone Solar PV Systems and Grid-Connected Solar PV Systems in terms of design, components, and performance. Recommend a more suitable system for both urban and rural areas with proper justification CO4- Ana (20)

Or

- (b) Analyze the efficiency factors of Concentrating Photovoltaic (CPV) systems compared to traditional photovoltaic systems. Discuss how concentration ratios, multi-junction solar cells, and cooling mechanisms influence overall system performance and energy output. CO4- Ana (20)

5. (a) Analyze the different types of power tariffs used for energy consumption. Compare their advantages and disadvantages for residential, commercial and industrial consumers. CO5- Ana (20)

Or

- (b) Analyze the trade-off between capital costs and operating costs for different types of power plants. Discuss how technologies with high capital costs, such as nuclear and renewable energy plants, can have lower operating costs compared to fossil fuel-based plants, and explain the economic implications of this trade-off over the plant's lifetime. CO5- Ana (20)