

**THE KAVERY ENGINEERING COLLEGE**  
(An Autonomous Institution)

M.E DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

*Second Semester*

*Power System Engineering*

PS4092- Renewable Energy and Grid Integration

*Regulations - 2021*

*Duration : 3 Hrs*

*Maximum: 100 Marks*

**PART - A(ANSWER ALL QUESTIONS) (Marks 10\*2=20)**

| <i>Q.No</i> | <i>Questions</i>                                                     | <i>BLT</i> | <i>CO</i> | <i>Marks</i> |
|-------------|----------------------------------------------------------------------|------------|-----------|--------------|
| 1.          | List four environmental benefits of using renewable energy sources.  | RE         | 1         | 2            |
| 2.          | Define matrix converter.                                             | UN         | 1         | 2            |
| 3.          | Define the term "short-circuit current" (Isc) in a PV cell.          | RE         | 2         | 2            |
| 4.          | Infer the role of bypass diodes in a PV array.                       | UN         | 2         | 2            |
| 5.          | Define Betz limit, and mention its significance in wind energy.      | UN         | 3         | 2            |
| 6.          | Mention the role of pitch control in wind turbines.                  | RE         | 3         | 2            |
| 7.          | List the two primary methods of MPPT.                                | RE         | 4         | 2            |
| 8.          | Define "fill factor" in a photovoltaic cell.                         | UN         | 4         | 2            |
| 9.          | Name two types of batteries commonly used in energy storage systems. | RE         | 5         | 2            |
| 10.         | Infer the purpose of a PV-Diesel hybrid system.                      | UN         | 5         | 2            |

**PART - B (ANSWER ALL QUESTIONS) (Marks 5\*13 = 65)**

| <i>Q.No</i> | <i>Questions</i>                                                                                                                                             | <i>BLT</i> | <i>CO</i> | <i>Marks</i> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|--------------|
| 11.         | a i Explain the grid code regulations in India and compare them with those of another country.                                                               | UN         | 1         | 8            |
|             | ii Summarize the impacts of renewable energy penetration on grid stability and reliability.                                                                  | UN         | 1         | 5            |
|             | Or                                                                                                                                                           |            |           |              |
|             | b i Explain the process of AC-DC-AC conversion and its significance in renewable energy systems.                                                             | UN         | 1         | 8            |
|             | ii Discuss the importance of PWM in inverter technology for renewable energy integration.                                                                    | UN         | 1         | 5            |
| 12.         | a Analyze the I/V and P/V characteristics of a PV cell and discuss how these characteristics change with variations in insolation, temperature, and shading. | AP         | 2         | 13           |
|             | Or                                                                                                                                                           |            |           |              |
|             | b Explain the components and operation of a grid-connected PV system, including inverter types and grid synchronization issues.                              | AP         | 2         | 13           |
| 13.         | a Analyze the power curve of a wind turbine and explain how it relates to operational efficiency and energy production.                                      | AP         | 3         | 13           |
|             | Or                                                                                                                                                           |            |           |              |
|             | b Analyze the operational characteristics of variable speed PMSGs and their advantages over fixed-speed systems.                                             | AP         | 3         | 13           |

|     |   |                                                                                                                                |    |   |    |
|-----|---|--------------------------------------------------------------------------------------------------------------------------------|----|---|----|
| 14. | a | Discuss the impact of environmental conditions, such as irradiance and temperature, on PV power output and MPPT effectiveness. | UN | 4 | 13 |
|     |   | Or                                                                                                                             |    |   |    |
|     | b | Compare and contrast the Perturb and Observe (P&O) method with the Incremental Conductance (IC) method of MPPT.                | UN | 4 | 13 |
| 15. | a | Describe the key functions of battery energy storage systems (BESS) in renewable hybrid systems.                               | UN | 5 | 13 |
|     |   | Or                                                                                                                             |    |   |    |
|     | b | Explain the features and challenges of Wind-PV hybrid systems and discuss how these systems are optimized for efficiency.      | UN | 5 | 13 |

*PART – C (Marks 1\*15 = 15)*

| <i>Q.No</i> |   | <i>Questions</i>                                                                                                                                        | <i>BLT</i> | <i>CO</i> | <i>Marks</i> |
|-------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|--------------|
| 16.         | a | Explain the design process for a PV system and analyze the load calculation, array sizing, and the selection of system components.                      | AN         | 2         | 15           |
|             |   | Or                                                                                                                                                      |            |           |              |
|             | b | Derive the expression for the power contained in the wind and analyze how factors like air density, wind speed, and rotor area affect power generation. | AN         | 3         | 15           |