**Q. Code:238358**

**Reg. No.** | | | | | | | | | | | | | |

# B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2023

Seventh Semester

## EE18704 – WIND AND SOLAR ENERGY SYSTEMS

Electrical and Electronics Engineering

**(Regulation 2018)**

**TIME: 3 HOURS** **MAX. MARKS: 100**

**CO 1** Realize the need and structure of wind and solar energy based generation
**CO 2** Model fixed and variable speed wind energy conversion systems
**CO 3** Design and apply solar PV system for electrical applications
**CO 4** Analyze the standalone and grid connected operation of solar PV and wind energy conversion systems

**PART- A (10 x 2 = 20 Marks)**

(Answer all Questions)

| | | CO | RBT LEVEL |
|---|---|---|---|
| **1.** | Interpret the implementation of an aerofoil design in wind turbine blades. | **1** | **2** |
| **2.** | Identify the problems associated with tapping solar energy. | **1** | **2** |
| **3.** | What is constant speed constant frequency systems in WECS? | **2** | **1** |
| **4.** | Why are induction generators preferred over DC generators in WECS? | **2** | **2** |
| **5.** | Compare fixed and variable speed wind energy conversion systems. | **2** | **2** |
| **6.** | Express the steady state equation of PMSG. | **2** | **2** |
| **7.** | How maximum power point tracking is employed in solar PV systems? | **3** | **2** |
| **8.** | What are the factors to be considered for the selection of inverter for solar energy conversion system? | **3** | **1** |
| **9.** | List the various impacts of high penetration of wind power in to power grid. | **4** | **2** |
| **10.** | What is meant by fault ride through capability? | **4** | **1** |

**PART- B (5 x 14 = 70 Marks)**

| | | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|---|
| **11. (a)** | | Analyse the various components of wind energy conversion systems. | **(14)** | **1** | **4** |
| | | **(OR)** | | | |
| **(b)** | **(i)** | Differentiate between horizontal and vertical axis wind turbines. | **(7)** | **1** | **4** |
| | **(ii)** | Identify the various impacts of wind and solar energy generation on the environment and investigate the effects of it. | **(7)** | **1** | **4** |

| | | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|---|
| **12. (a)** | | Derive the induction generator's steady state model and evaluate the performance characteristics. | **(14)** | **2** | **4** |
| | | **(OR)** | | | |
| **(b)** | **(i)** | Illustrate and explain the power Vs wind speed characteristics for constant speed generation scheme. | **(7)** | **2** | **4** |
| | **(ii)** | Describe the drive train model using the appropriate equations. | **(7)** | **2** | **4** |
| **13. (a)** | | Describe different modes of operation of DFIG and derive the steady state model for DFIG from basics. | **(14)** | **2** | **4** |
| | | **(OR)** | | | |
| **(b)** | | Analyse the basic structure, model and operation of PMSG based WECS. | **(14)** | **2** | **4** |
| **14. (a)** | | Discuss the various aspects of selection of inverter, design of batteries and arrays for solar PV energy conversion system. | **(14)** | **3** | **3** |
| | | **(OR)** | | | |
| **(b)** | | Using the solar PV cell characteristics, demonstrate the maximum power point tracking and list various MPPT algorithms. | **(14)** | **3** | **3** |
| **15. (a)** | | Demonstrate the grid integrated operation of solar PV systems with a neat sketch. | **(14)** | **4** | **3** |
| | | **(OR)** | | | |
| **(b)** | | Depict and discuss the operation of standalone fixed and variable speed WECS. | **(14)** | **4** | **3** |

## PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| **16.** | The following electrical appliances are used in a residential house:<br>• Three 40 Watts fluorescent lamp used for 6 hours per day.<br>• Two 60 Watts fan used for 4 hours per day.<br>• One 100 Watts refrigerator that runs 24 hours per day with compressor run 12 hours and off 12 hours.<br>The system will be powered by 12 V DC, 110 Wp PV module with panel generation factor of 3.4. Design a solar PV array suitable for this house along with the battery sizing. | **(10)** | **3** | **5** |

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