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Question Paper Code : 17949

M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Elective

Electrical Drives and Embedded Control

PS 7007 – WIND ENERGY CONVERSION SYSTEMS

(Common to M.E. Power Electronics and Drives and M.E. Power Systems Engineering)

(Regulations 2013)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the factors responsible for distribution of wind energy on the surface of the earth?

2. Draw the torque-speed curve of a wind turbine.

3. Define tip-speed ratio.

4. What are the types of stall control?

5. What is the drive train model of wind turbine?

6. What are the deciding factors to be considered for the selection of generator in WECS?

7. What are the Variable Speed Variable Frequency (VSVF) schemes?

8. Define furling speed.

9. What are the interconnection requirements for wind power plants?

10. List the ramp rate limitations.

PART B — (5 × 13 = 65 marks)

11. (a) Explain the functions of various blocks of wind energy conversion system.
                                                                                (13)

Or

   (b) Explain the aerodynamics of wind turbine by Blade-element theory analysis.   (13)

12. (a) Explain the design of wind turbine rotor based on : (13)

    (i) Choice of Number of blades

    (ii) Choice of the Pitch angle.

Or

(b) A two-blade wind turbine is to produce 75 kw of mechanical power. The blades are of 9 m length and the axis to inner edge distance is 0.5 m. Assuming three blade elements of equal length, find the optimal chord length for each blade element by equalizing (i) the thrust and (ii) the moment. Profile : RG14, TSR = 8.5, $V\infty = 10$ m/s; take the pitch angle α in each element to correspond to the maximum aerodynamic efficiency. (13)

13. (a) Derive the dq model of induction generator. (13)

Or

(b) Give the steady-state model of a non-salient pole synchronous machine. (13)

14. (a) Explain with relevant waveforms, the interface of wind turbine using variable speed synchronous generator with a boost rectifier to a dc load. (13)

Or

(b) Explain the Variable Speed Variable Frequency (VSVF) operation in WECS. (13)

15. (a) Explain Low Voltage Ride Through (LVRT) control strategy of grid-connected variable speed wind turbine generator system. (13)

Or

(b) Discuss on the supply of ancillary services for frequency and voltage control. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Calculate the power developed by a 48 meter rotor diameter gear coupled Wind turbine generator fixed at 55 meters hub level, when subjected to a wind power density of 250 Watts per square meter. The co-efficient power activated in the wind turbine blade is 48%. The gear box and coupling conversion efficiency together is 92%. The conversion efficiency of the Doubly Fed induction generator is 92%. (15)

Or

(b) Which generator is better to use for wind turbine power generation? Justify your answer. (15)

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