Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –IIst SEMESTER–EXAMINATION – JULY- 2012

Subject code: 1723901 Date: 06/07/2012

Subject Name: Wind Energy Engineering

Time: 10:30 am – 13:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Derive the Bet'z Limit for wind turbine **07**

(b) Explain the rotor disk theory with necessary derivatives. **07**

Q.2 **(a)** State the relationship of power sensitivity to rotor radius and wind speed. **07**

(b) The following data refers to a wind mill. **07**
Average annual wind speed: 22.8 m/s
Induction factor for wind m/c = 0.15
Average air density ρ = 1.16 kg/m^3
Total power capacity = 1.1 MW
Determine available power capacity in wind , power coefficient of wind mill, power density available at wind m/c, total wind farm area required no. of wind mills if rotor diameter is 32 m.

OR

(b) It is required to design a wind machine for pumping water. Determine basic factor of wind m/c based on following. **07**
Average speed of wind = 18 km/hr
Mean air density = 1.017 kg/m^3
Water flow rate = 1000 ltr/hr
Pump head = 28 m
Pump efficiency = 55 %
Transmission losses = 6 %
Power coefficient of machine = 0.324

Q.3 **(a)** Give classification of wind turbine along with neat sketch. **07**

(b) Design a propeller type windmill based on following data. **07**
Capacity = 55 KW
Average air density ρ = 1.16 kg/m^3
TSR = 4.1
Wind speed = 34 km/he
Determine
1. Rotor diameter
2. Blade area
3. Mean blade dimension
4. Rotor speed

OR

Q.3 **(a)** Describe electrical layout of a typical wind farm by means of single line diagram. State the essential equipment. **07**

(b) Explain with diagram how a wind farm is controlled? Which are the hierarchical control levels? **07**

Q.4 **(a)** Give classification of Anemometers and explain anyone **07**

(b) Write short note on following. (Any Three) **07**

1. VFD
2. PLC and its application.
3. Facts control
4. SCADA

OR

Q.4 **(a)** With suitable diagram explain classification of inverters. **07**

Q.4 **(b)** Explain following with respect to wind turbine **07**
"Power generation through aerodynamic action"

Q.5 **(a)** Explain any four of following. **14**

1. Conservation of energy in wind turbine
2. Impact of wind farm on wild life
3. Power density
4. Lift based turbine
5. Power curves
6. Stall v/s Pitch regulated turbine
7. Forces and moments in wind turbine
8. Atmospheric boundary layers

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