Continuing Education Course #181
Introduction to Small-Scale Wind Project Design

1. What type of wind turbines needs to have a kind of yaw control to line up the device with the wind?
- a. HAWTs.
- b. VAWTs.
- c. Drag-driven turbines.
- d. Lift-driven turbines.

2. Which kind of wind turbine has comparatively lower speeds of rotation and higher torque?
- a. HAWTs.
- b. VAWTs.
- c. Drag-driven turbines.
- d. Lift-driven turbines.

3. Wind turbines that have blades with an airfoil shape can always be classified as what type of turbines?
- a. HAWTs.
- b. VAWTs.
- c. Drag-driven turbines.
- d. Lift-driven turbines.

4. For which genre of wind turbines are there the most concerns with high speed vibration and noise issues?
- a. HAWTs.
- b. VAWTs.
- c. Drag-driven turbines.
- d. Lift-driven turbines.

5. For the geometry of a lift-driven wind turbine blade, lift:
- a. produces an “apparent wind” vector on HAWTs.
- b. is a force that has a component that acts to pull the hub forward.
- c. is an effect that counteracts turbulence.
- d. is a force that has a component that acts to turn the blades.

6. A critical prerequisite in producing lift on lift-driven wind turbine blades is:
- a. that the air moving over the blade remains attached to most of the blade’s airfoil surfaces.
- b. that the placement of the turbine is in the wake of upwind structures.
- c. that there is disruption of laminar flow over the blade’s airfoil surfaces.
- d. all of the above.

7. The Betz limit refers to:
- a. the maximum cut-out speed for wind turbines in high speed environments.
- b. the maximum theoretical kinetic energy that a turbine can extract from the wind.

○ c. the highest elevation a turbine can operate due to low air density effects.
○ d. the spacing of multiple wind turbines at a single site.

8. What are the three things that determine the energy in the wind that is passing through a turbine?
○ a. the air density, the Betz limit, and the blade tip speed.
○ b. the wind speed, direction, and hub elevation.
○ c. the air's density, volume, and speed
○ d. the cube of the wind speed, the power coefficient, and the tip speed ratio.

9. The average wind speed at an ocean-side site is about 10 meters per second (m/s) or 22.4 miles per hour (mph). What is the approximate average theoretical available wind power (in watts) passing through a one square meter area?
○ a. about 0.6 watts.
○ b. about 613 watts.
○ c. about 1,225 watts.
○ d. about 6,856 watts.

10. When the wind at a sea level site is blowing at 10 m/s (or 22.4 mph), what is the approximate power output wattage of a HAWT with a 100 cm blade radius and a coefficient of power of 0.35?
○ a. about 6,735 kilowatts.
○ b. about 7.44 kilowatts
○ c. about 673 watts
○ d. about 0.6 watts

11. What is the name of the velocity of wind that is the lowest speed that a wind turbine provides usable power?
○ a. the cut-out speed
○ b. the cut-in speed
○ c. the Betz speed
○ d. the rated speed

12. In general, what is the most important factor in determining available wind energy?
○ a. elevation, and hence the density of the air
○ b. the effects of the Betz limit.
○ c. the diameter of the turbine blades
○ d. the sustained velocity of the wind

13. Establishing a "wind resource" for a site means estimating:
○ a. the potential cash-flow of a wind project.
○ b. the average wind velocity at the nearest weather station.
○ c. the annual range of wind speeds and their comparative durations.
○ d. the peak wind speed in the immediate vicinity.

14. What is a histogram that plots the proportion of time that wind blows between narrow ranges of wind speed called?
○ a. a Wind Speed Distribution
○ b. a Wind Power Classification Chart
○ c. a plot of Betz's Law.
○ d. a Wind Turbine Power Curve.

15. What is the name of a well-documented probability distribution that is used to describe typical wind speeds?
○ a. the Walter distribution.
○ b. the Betz distribution.

○ c. the normal (or “Bell Curve”) distribution
○ d. the Weibull distribution

16. The Raleigh probability distribution:
○ a. is used in the specs of some wind turbine makers.
○ b. is produced when a Weibull distribution has a shape factor k of 2.
○ c. has an average speed greater than the most probable speed.
○ d. all of the above.

17. An airport meteorological station in West Texas has a 9 mph average wind speed. If a wind turbine with a 30 meter hub-height were constructed right next to this station, what would be a reasonable estimate of the average wind speed at the hub?
○ a. 10.5 mph
○ b. 14.5 mph
○ c. 24.3 mph
○ d. 43.0 mph

18. If you can sell power back to the utility at 8 cents per kilowatt-hour, what would be a reasonable estimate of the annual income from a HAWT with 6 foot diameter blades located at a coastal site with 17 mph average wind speed?
○ a. about $18.80 per year.
○ b. about $187.90 per year.
○ c. about $751.90 per year.
○ d. about $1,879.0 per year.

19. If you install a wind generator with a rated speed of 15 mph at a site with an average annual wind speed of 10 mph, what is a reasonable expected range of the percentage of time that the generator will operate BELOW its rated speed?
○ a. 7% to 17%
○ b. 19% to 33%
○ c. 30% to 50%
○ d. 82% to 93%

20. The most desired data for producing a believable wind project feasibility study would include:
○ a. the listing from an on-line wind atlas.
○ b. output from an NREL computer model
○ c. a Raleigh distribution generated from an average wind speed.
○ d. wind speed measurements taken at the actual project site.

21. The definite minimum time for collecting site wind data for project planning is:
○ a. 24 months
○ b. 12 months
○ c. 3 months
○ d. 1 month

22. A practical and inexpensive first step in addressing potential issues about noise levels of a proposed wind site would be:
○ a. to apply for a variance on all zoning restrictions for green energy projects.
○ b. to construct a computer model of the site.
○ c. to retain an outside wind energy consultant/attorney.
○ d. to ask candidate turbine manufacturers for data on acoustical performance

23. To what does “balance-of-system” equipment generally refer when talking about wind power systems?

- a. the vibration control devices installed for the blades.
- b. system components in addition to the wind turbine and its tower.
- c. electrical phase detection circuitry
- d. devices purchased by the utility, and not the wind site operator.

24. What kind of arrangement/contract generally pays the wind site operator the highest per unit energy delivered to the utility?

- a. a Net Purchase and Sale arrangement.
- b. a Net Metering arrangement.
- c. an indemnifying liability arrangement.
- d. an IEEE, UL & NEC compliant contract.

25. What type of agreement/contract is generally required for wind systems that are tied to a utility grid?

- a. an interruptible service agreement.
- b. an Energy Savings Performance Contract (ESPC).
- c. a peak-demand contract.
- d. an interconnection agreement.