

College of Engineering, Pune

END SEMESTER EXAM

B.Tech (Electrical)

Subject: Wind and Solar Power

Maximum Marks - 50

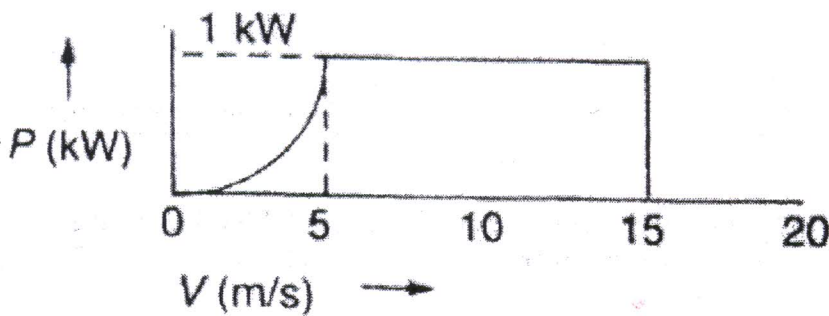
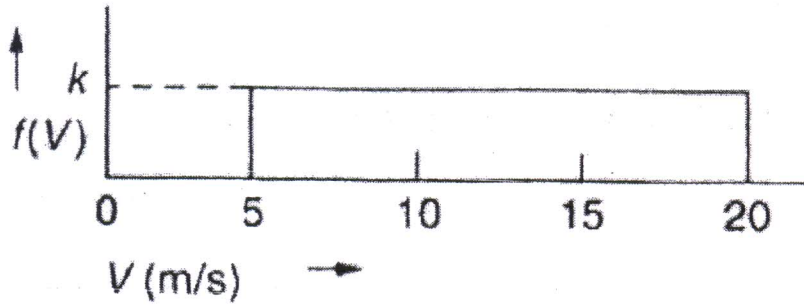
Duration - 3 Hours

Instructions to candidates:

- 1) Neat Diagrams must be drawn wherever necessary.
 - 2) Figures to the right indicate full marks.
 - 3) Start answers of each question on new page.
 - 4) Assume suitable data if required and mention the data which you have assumed.
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- Q.1a) Explain the direct power control method as applied to the DFIG. Derive the modeling equations for the dynamic plant model in the stator stationary reference frame. (10)
- Q.1b) Explain the MPT for a wind turbine generator system. How it is achieved? (4)
- Q.1c) A 30 m, three bladed wind turbine mounted at a location having a height of 1600 m above the mean sea level, produces 650 kW at a wind speed of 15 m/s. Under these conditions, (4)
- (i) If the rotor rotates at a speed of 0.56 rps, what will be the tip speed ratio?
 - (ii) What is the tip speed of the rotor?
 - (iii) If the generator needs to turn at 1800 rpm, what gear ratio is needed?
 - (iv) What is the efficiency of the complete wind turbine generator system under these conditions?
- Q.2a) Discuss various tracking modes for the parabolic trough collectors. (8)
- Q.2b) Calculate the angle of incidence for a flat plate collector located at Pune (18°31'N, 73° 51'E) on 14th March at 10 a.m. (IST) if the angle of angle of tilt is 31°, equation for time correction is (-10) minutes and surface is pointing due south. Also calculate the zenith angle, solar azimuth angle and tilt factors for beam and diffuse radiation. (8)

Q.3a) Suppose the wind probability density function (p.d.f.) is just a constant over the 5 to 20 m/s range of wind speeds as shown below. The power curve for a small 1 kW windmill is also shown. (8)



- What is the probability that the wind is blowing between 5 and 15 m/s?
- What is the annual energy that the wind turbine would generate?
- What is the average power (W/m^2) in the wind?
- What is the capacity factor?
- If the wind regime follows Weibull statistics instead of the above p.d.f. with shape and scale parameter 3 and 14 m/s respectively, what is the probability of wind speeds less than 15 m/s?

Q.3b) Explain the FRT requirements for the wind farms. Compare Basic wind turbine technologies with respect to their FRT capabilities and measures to achieve FRT. (8)

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Best of luck!