MEE1067 Wind Energy Engineering E1

1 A 3-bladed wind turbine with 292 kW generator has diameter of 60 m and tower height of 95 m. It is designed to have C_p of 0.188 at wind speed of 20 m/s when regulation starts. The cut-in and furling Speeds for the machine are 8 m/s and 26 m/s respectively. Mechanical and electrical efficiencies are 98% and 95%. By assuming the density of air as 1.224 kg/m^3, Calculate:
a. What is power developed by the rotor at 20 m/s when regulation starts?
b. If the tip-speed ratio at this wind speed is 5, then what is the rpm of the rotor?
c. Calculate the actual torque developed.
d. Calculate the maximum possible annual power output.

2.A wind data acquisition system located at certain site measures 6.5 m/s 55 times, 7 m/s 47 times, 8 m/s 71 times, 9.5 m/s 85 times, 10 m/s 51 times, 10.5 m/s 61 times, 11 m/s 49 times, 12 m/s 57 times, 12.5 m 56 times and 13m/s 45 times during a given period. Find the mean, variance, and standard deviation. Find the probability of each wind speed being observed. What is the probability that the wind speed will be 10 m/s or greater?

3.A wind turbine with 7 m radius rotor. Speed of the rotor at 32 m/s wind velocity is 192 rpm and its power coefficient at this point is 0.28. Calculate the tip speed ratio and torque coefficient of the turbine. What will be the torque available at the rotor shaft? Assume the density of air to be 1.224 kg/m^3.