Name: **Enrolment No:**	

UPES

End Semester Examination, May 2023

Course: Wind Energy Technology **Semester : IV**

Program: B Tech (RSEE) **Time : 03 hrs.**

Course Code: EPEG2022 **Max. Marks: 100**

Instructions: Read the questions properly and try to answer in bullet points whereas applicable.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Derive the following: Drag Force, Lift Force, Axial Force, Tangential Force, Solidity	**4**	**CO1**
Q 2	Differentiate between HAWT and VAWT with suitable examples.	**4**	**CO1**
Q 3	Explain the variation of the power output of a wind turbine with the tip speed of the rotor.	**4**	**CO2**
Q 4	Using the Betz model of a wind turbine, derive the expression for power extracted from the wind.	**4**	**CO2**
Q 5	Explain various designs of blades of VAWTs and their relative feature.	**4**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

Q 6	A HAWT has the following data: Speed of wind 10 m/s at 1 atm and 15°C Diameter of rotor = 120 m Speed of rotor 40 rpm Calculate the maximum possible torque produced at the shaft.	**10**	**CO3**

Q 7	Calculate the rotor radius for a wind turbine operating at a wind speed of 7 m/s to pump water at a rate of 5 m^3/h with a lift of 6 m. Also, calculate the angular velocity of the rotor. Use the following data: Water density p-1000 kg/m, g-9.8 m/s, water pump efficiency 45%, the efficiency of the rotor to pump 80%, power coefficient, C, 0.25, tip speed ratio, 2= 1.1, air density, 1.2 kg/m.	**10**	**CO3**
Q 8	An aero-generator, installed at sea shore generates an output of 1200 W at a wind speed of 6 m/s at a temperature of 27 °C. What will be the output, if the same aero-generator is installed on the top of a hill where the temperature is 15 °C, pressure is 0.85 atmospheric, and wind speed is 8 m/s?	**10**	**CO4**
Q 9	Derive the expression of Axial Thrust on Turbine, F_A and Torque Developed by the Turbine, T. Or, Explain the working principle of the Wind Energy Conversion Systems with the block diagram.	**10**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q 10	What factors led to the accelerated development of wind power? What do you understand by a gust? Or, With the help of a diagram, discuss the power versus speed characteristics of a Wind Turbine.	**20**	**CO5**
Q 11	A propeller-type wind turbine has the following data: Speed of free wind at a height of 10 m= 12 m/s Air density= 1.226 kg/m^3 α=0.14	**20**	**CO5**

	Height of tower=100 m Diameter of rotor= 80 m Wind velocity at the turbine reduces by 20% Generator efficiency= 85% 1. Find: 2. Total Power available in the wind 3. Power extracted by the turbine 4. Electrical power generated 5. Axial thrust on the turbine 6. Maximum axial thrust on the turbine		