 PG/1st/PGET103

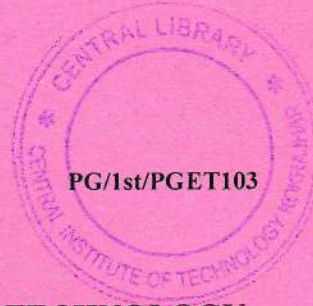**2021**

FUNDAMENTALS OF ENERGY TECHNOLOGY
Full Marks: 100

Time: Three hours

The figures in the margin indicate full marks for the questions.

Answer any five questions.

1. (a) Write about the energy scenario in India.   5

   (b) Derive the total power contained in the wind flowing through the swept area A.   5

   (c) Calculate the total wind power in an area where the average wind speed is 6 m/s, using a WPP with a 60 metre rotor diameter. Assume air temperature is 25 degree centigrade with a density of 1.225 kg/m³.   10

2. (a) Write down the factors affecting the performance of rotor of wind power plant.   5

   (b) What is aerodynamic efficiency?   5

   (c) A wind power plant of 80 m rotor diameter is rotating at a particular windy site with the average wind speed of 6 m/s at a power co-efficient of 0.4. Assuming the air temperature as 25 degree with a density of 1.225 kg/m³. Calculate the (i) power density of air (ii) maximum possible power density (iii) actual power density (iv) power output from the WPP.   10

3 (a) What is tip speed ratio.   5

   (b) Draw the curves showing the relation of TSR and power   5
        coefficient for different types of WPP.

   (c) A WPP has rotor diameter of 80 meter. The RPM is 15   10
        and the wind speed is 8 m/s. The power coefficient is 0.4.
        Assuming the air density as 1.225 kg/m^3, find the torque
        coefficient C_T. Also find the torque available at the rotor
        shaft.

4 (a) What is thrust force?   5

   (b) Derive the equation $C_p/C_T=\lambda$.   5

   (c) Draw an approximate equivalent circuit of a wound rotor   10
        induction machine. Derive the relation between stator d-q
        axis current and rotor d-q axis current. Also draw the
        phasor diagram.

5 (a) Is it possible to harness all the kinetic energy present in   5
        the wind?

   (b) Write about the solar thermal system.   5

   (c) Draw the rotor current vector in rotor and stator   10
        coordinates. Derive the value of $\cos\rho_1, \cos\rho_2, \sin\rho_1, \sin\rho_2,$

6 (a) What is biomass?   5

   (b) How is biomass formed?   5

   (c) Derive the work done and efficiency of a Pelton wheel.   10