INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Mid-Spring Semester Examination 2022-23

Date of Examination: _____ **Session: (FN/AN)** _____ **Duration: 2 hrs. Full Marks: 30**

Subject No.: AG31008 **Subject:** Post Harvest Engineering

Department/Center/School: Agricultural and Food Engineering

Specific charts, graph paper, log book etc., required Graph paper

Special Instructions (if any): _____

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1. Moist air has absolute humidity of 25 g water vapor/kg dry air and 50% RH. Obtain the specific volume, dry bulb temperature, wet bulb temperature, dew point temperature and enthalpy of the moist air with the help of psychrometric chart. Draw the chart and indicate the path/lines to obtain the values. **[5]**

2. Industry requires to supply hot air of 80°C to carry out drying operation. A heating coil is used to heat the ambient air at 25°C and 45% RH. If the volumetric flow rate of ambient air is 5 m^3/s, calculate the power supply to the heating coil, specific volume, relative humidity, specific heat capacity, and enthalpy of air after heating without using psychrometric chart. **[12]**

3. Freshly harvested paddy with 20% (wb) moisture is required for drying. How much fresh paddy is required for obtaining a final amount of 8000 kg paddy with 12% (db) moisture? **[3]**

4. Which of the following statements are true and false: **[3]**

   i. The wet bulb temperature of an air-water vapor mixture is lower than the dry bulb temperature but higher than the dew point temperature.
   ii. The wet bulb temperature line of an air-water vapor mixture follows exactly the adiabatic saturation temperature line.
   iii. The wet bulb temperature of an air-water vapor mixture is equal to the dry bulb temperature when the relative humidity is equal to 100%.
   iv. Water activity of sugar-water solution is 1.00.
   v. The final moisture content of the dried product depends on relative humidity of drying air.
   vi. Unbound moisture content exerts a vapor pressure equal to the vapor pressure of pure water at the same temperature.

5. Define water activity.
   A food material follows the BET model at 50°C. From an experiment, the following moisture content was obtained at different water activity:

a_w	0.05	0.10	0.20	0.30	0.40	0.50
m, (%db)	2.50	3.50	6.00	7.50	8.50	9.50

   Obtain the parameters of the BET model (attach the graph paper with answer script). **[2+5]**

Useful formula:

$$p_{ws} = e^{\left(23.06 - \frac{3724}{222.86+t}\right)}$$

$$m = \frac{m_0 C K a_w}{(1 - K a_w)(1 - K a_w + C K a_w)}$$

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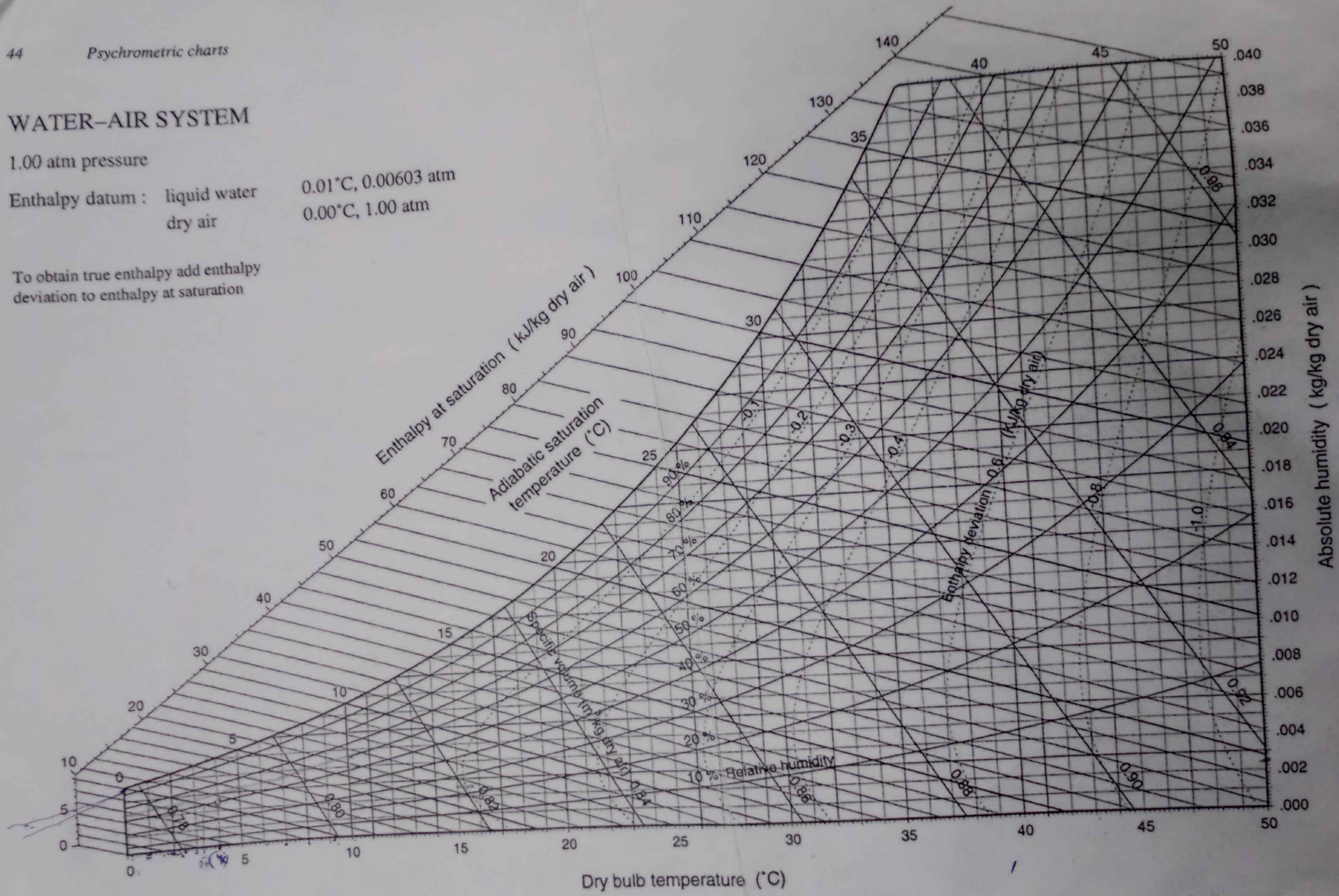
WATER–AIR SYSTEM

1.00 atm pressure

Enthalpy datum : liquid water 0.01°C, 0.00603 atm
dry air 0.00°C, 1.00 atm

To obtain true enthalpy add enthalpy deviation to enthalpy at saturation



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