INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date: .04.2012 (FN/AN)   Time: 3 hours   Full Marks 50   No. of students: 45
Spring Semester 2012   Deptt. AgFE   Subject No.: AG31008
3rd year B.Tech.   Subject: Post Harvest Engineering

Instruction: Part-A is compulsory. Attempt any 4 questions in Part-B.

PART-A

Q1.

a)   A dryer is to be constructed for removing 45.3 kg of water per hour. Air is supplied to the dryer at normal atmospheric pressure and temperature of 66°C. The air leaves the dryer at barometric pressure of 100.66 kPa and 35°C. The dew point temperatures of the inlet and outlet air streams are 4.5°C and 24°C, respectively. Calculate,
  i)   Humidity of the air at inlet and outlet ports of the dryer.
  ii)   Volumetric flow rate (kg h^{-1}) of air at the inlet conditions.

[4+4=8]

- Correlation for vapour pressure of water (p in kPa and temperature t in °C):

$$\ln p = 18.6556 - \frac{5217.635}{t+273}$$

b)   While it was raining, one measured the temperature and pressure of air as 25°C and 101.325 kPa, respectively. Obtain the dew point and wet bulb temperatures of the air.

[2]

PART-B

Q1 a) Explain why the design of a grain silo is different from that of a water tank.   [2]

b) Analysing the sresses in grain silos derive Janssen's equation.   [4]

c) Derive an expression for determining the effectiveness of a rice polisher.   [4]

Q2 a) Discuss the tempering-degerming process of corn milling.   [4]

b) Wheat at 8.5% moisture content was smeared with 105 kg of liquid water for conditioning. Assume that all the water was absorbed by grains. The conditioned grains were ground in a closed mill without loss of moisture. 25 gram of a sub-sample from the resultant flour was kept in a hot air oven at 120 °C for 2 hours and dry matter of the sample was determined as 20.4 g. Calculate the mass at 8.5% m.c. originally taken for size reduction.   [4]

Q3: a) Discuss the importance of mathematical modelling of the drying process.   [2]

b) Describe the mechanical expelling and solvent extraction methods used for producing groundnut oil.   [4]

c) In a thin layer drying experiment, following observations were made:

Drying time (minutes)	0	15	30	45	60	75	90
M.C. (% d.b.)	745.0	318.5	129.2	36.4	12.7	6.6	6.6

EMC was 70% of the final moisture content attained during the drying trial. Evaluate the coefficients of a suitable mathematical model based on this experiment. Determine the correlation coefficient for this model.   [4]

Q4 a) Explaining the working principle of a Centrifugal sheller derive an expression for determining the centrifugal force generated by an impeller.   [4]

b) Shelled rice is fed to a cone polisher @ 1545 kg/h. Composition of inlet and outlet streams is observed as follows:

Stream	Composition, %			
	Paddy	Head Rice	Broken Rice	Rest
Sep Rice	0.00	86.90	12.70	0.40
PR	0.00	60.40	39.50	0.10
Bran	0.00	2.70	18.60	78.70

1000 grain weight of brown rice and polished rice is observed as 19.947 and 17.482 g respectively. Calculate the polishing effectiveness, head rice effectiveness and bran separation effectiveness during the polishing operation assuming an optimum degree of polish.   [6]

Q5: Write short notes on any five:

- Hydrothermal treatment/conditioning of grains
- Specific gravity separators
- Cyclone separator
- Destoner
- LSU dryer
- Wet milling of pigeon pea
- Wheat milling process
- Separation effectiveness of a cleaner for binary mixture
- Length of husking zone of a rubber roll sheller   [2x5]