

**DEPARTMENT OF AGRICULTURAL AND FOOD ENGINEERING
IIT KHARAGPUR**

Autumn Mid Sem. Exam, 2010-2011

Date of Examination -14.09.2010

Time 2 hrs

Full Marks 30

Subject no: AG60301(M. Tech)/AG60023(DD)

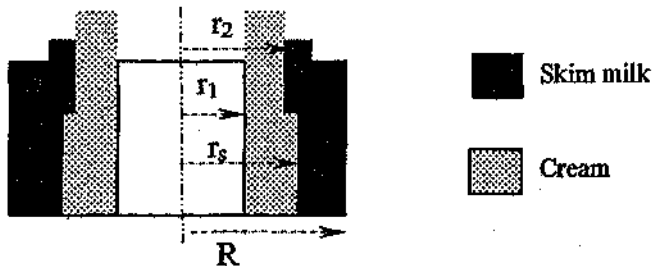
Subject Name: Advanced mechanical Operations in Food Processing (M. Tech)/Dairy and Food Processing Operations – I (Dual Degree)

No. of Students - M. Tech (28) + DD (11)

(Answer the following. START EACH ANSWER ON NEW PAGE; Marks will be deducted for Illegible hand-writing and without proper SI units of the parameters)

- Q.1 (a) Calculate the sphericity of a regular cylinder and a cone whose base diameter is 5 μm and height of 7 μm .
- (b) If $D_{3,2} = \left(\frac{\sum D_i^3 N_i}{\sum D_i^2 N_i} \right)$, what would be its expression in terms of mass fraction? What this diameter called?
- (c) Viscosity of a solution can be measured by falling ball viscometer. A coloured glass bead (average diameter 250 μm , specific gravity 2.5) was allowed to fall through an aqueous glycerol solution that took 100 s to travel a distance of 0.5m. If the density of glycerol solution is 1100 kg m^{-3} , what is its viscosity?
- (d) Show that $F_{centrifugal} = 0.001118rN^2$ times greater than gravitational force, where r is radius of the bowl and N is its rotational speed (rpm).
- (e) A cream separator centrifuge has an outlet discharge radius, $r_1 = 50.8$ mm and outlet $r_2 = 76.2$ mm. The density of skim milk and that of cream are 1032 and 865 kg m^{-3} , respectively. Calculate the radius of the interface. Calculate also the volumetric flow ratio of skim milk and cream when the centrifuge bowl diameter is 200 mm.

[2+3+4+3+8= 20]



- Q 2. A mixture of corn grit and small stone particles needs to be classified as far as possible. By primary screening with series of sieves, a fraction of mixture of grit and stone has been obtained whose size varies between 10 μm to 100 μm . This fraction is classified with differential classification method using water at 20°C. The specific gravity of stone particles and that of grits are 2.8 and 1.2 respectively. Calculate (a) pure fraction size ranges for grit and stone particles, and (b) the diameter range for remaining mixed fraction. Take density and viscosity of water as 1000 kg m^{-3} and 1.0 cP, respectively, and assume grits do not soak water.

[6]

- Q.3 A ball mill 1200 mm in diameter containing 250 stone balls (diameter 30 mm; density 2500 kg m^{-3}) of is running at 0.8 Hz. It is found that the mill is not working satisfactorily. Would you suggest any modification in its operation?

[4]