MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. END SEMESTER EXAMINATIONS NOV/DEC 2019

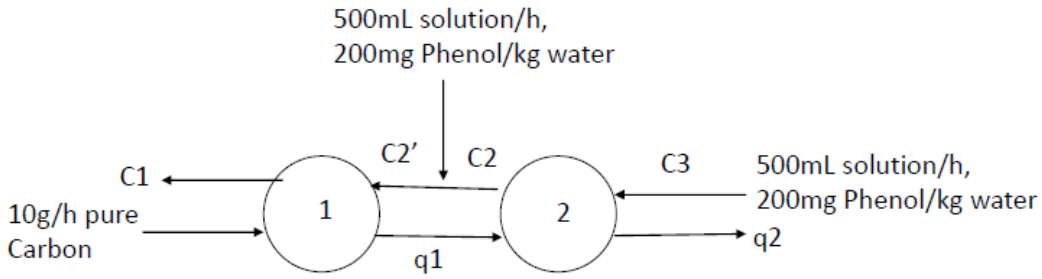
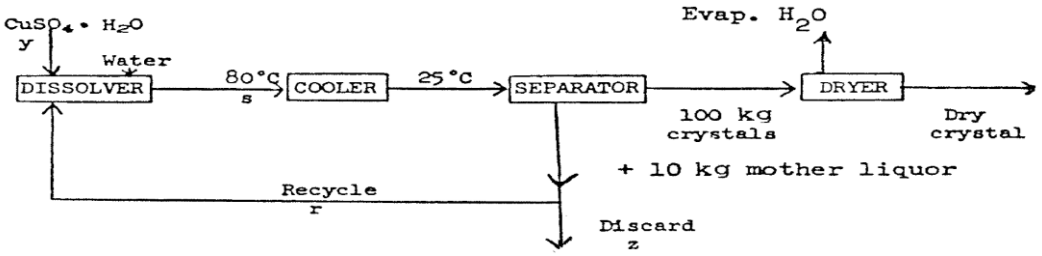
SUBJECT: SEPARATION TECHNIQUES IN BIOPROCESSING [BIO3103]

Date of Exam: **20/11/2019** Time of Exam: **2.00 PM – 5.00 PM** Max. Marks: **50**

Instructions to Candidates:

- Answer ALL the questions & missing data may be suitable assumed

<table>
<tr><td>1A.</td><td>Equilibrium partial pressure (PP) of CO_2 over aqueous solutions of Monoethanolamine (MEA, 30wt%) at 25^0C/1.2 atm pressure,
<table>
<tr><td>MoleCO_2/Mole solution</td><td>0</td><td>0.058</td><td></td><td>0.060</td><td>0.062</td><td>0.064</td><td>0.066</td><td>0.068</td><td>0.070</td></tr>
<tr><td>PP, mm Hg</td><td>0</td><td>5.6</td><td></td><td>12.8</td><td>29</td><td>56</td><td>98.7</td><td>155</td><td>232</td></tr>
</table>
A process plant produces a gas containing 15% mole CO_2 (rest inerts). The gas is to be cleaned in a scrubber with 4 trays. Scrubbing liquid (MEA, 30 wt %) is a recycled solvent contains 0.058 mole CO_2/mole solution. Column pressure is 1.2 atm (25^0C). For every m^3 of entering gas at the above conditions, determine solvent flow rate to reduce CO_2 content to 1.5% mole. Mol wt of MEA =61</td><td>6</td></tr>
<tr><td>1B.</td><td>i. Define and explain Resolution in Chromatography
ii. How does selectivity, capacity and efficiency affect resolution</td><td>2
2</td></tr>
<tr><td>2A.</td><td>A binary distillation column is operating under conditions specified: Feed rate= 350 kmole per hour, Overhead product rate=150 kmole/h, mole fraction of the overhead product=0.97 and that of bottom product= 0.02, Reflux ratio=3.5. In the stripping section it was found that mole fraction of the vapour phase leaving a particular plate is 0.33 while mole fraction of the liquid entering the same plate is 0.25. Determine q and number of trays.
<table>
<tr><td>x</td><td>0.1</td><td>0.2</td><td>0.4</td><td>0.6</td><td>0.8</td></tr>
<tr><td>y</td><td>0.2</td><td>0.4</td><td>0.7</td><td>0.8</td><td>0.9</td></tr>
</table></td><td>6</td></tr>
<tr><td>2B.</td><td>Describe,
i. Ion Exchange Chromatography
ii. Principles of Size Exclusion Chromatography and factors</td><td>4</td></tr>
<tr><td>3A.</td><td>Equilibrium relationship for adsorption of Phenol by Carbon is given by q=1.3*C, where q=amount of phenol adsorbed in mg Phenol per gram of Carbon, C= concentration of Phenol in mg per kg of water in solution. It is desired to treat 1 litre of a solution with phenol concentration of 200mg/kg water in 2 stage countercurrent treatment as sketched below. Feed Carbon is pure (10 g) and assume that 1 litre of solution contains 1 kg water. Determine final solution concentration (C_1) in mg-Phenol/kg-water. Assume basis as one hour of operation, and that 1 litre solution =1 kg water, no need to use graph</td><td>6</td></tr>
</table>

		
3B.	i. List some important properties of solvents for HPLC ii. Draw T-xy and H-xy diagrams for an ideal binary VLE system	**2** **2**
4A.	Draw the drying rate curve (rate of drying vs. Moisture content) and give reasons for the behavior when both Boundary Layer and Internal diffusion are controlling the drying i. hygroscopic material ii. non hygroscopic material iii. partially hygroscopic material	**4**
4B.	A porous slab is dried in a batch dryer under constant drying conditions. Seven hours are required to reduce the moisture content from 35% to 10%. The critical moisture content was fond to be 20% and the equilibrium moisture content was 4%. Assuming that the rate of drying during the falling rate period is proportional to the free moisture content, how long should it take to dry a sample of the same solid from 35% to 5% under the same drying conditions. All moisture contents are in dry basis (kg-moisture/kg dry solid), do not use graph and derive the equation you use.	**6**
5A.	$CuSO_4.H_2O$ containing 3.5% of a soluble impurity is dissolved continuously in sufficient water and recycled mother liquor to make a saturated solution at 80^0C. The solution is then cooled to 25^0C and crystals $CuSO_4.5H_2O$ are thereby obtained. These crystal carry 10% of their dry weight as adhering mother liquor. The crystals are then dried to zero free water. The allowable impurity in the product is 0.6%.  Determine discard z(kg), recycle r(kg), feed to cooler s(kg) and feed $CuSO_4.H_2O$ y(kg) Solubility of $CuSO_4.5H_2O$ at 80^0C is 120 g/100g free water and at 25^0C is 40g per 100g free water.	**9**
5B.	Highlight Oswald's ripening phenomena	**1**