

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

End-semester Examination - Winter 2018

Course: B. Tech in Chemical/ Petrochemical Engineering

Semester: III

Subject Name: Mechanical Operations

Subject Code: BTCHC304

Max Marks: 60

Date: 7/12/2018

Time: 03:00 Hrs

Instructions:

1. Solve ANY FIVE questions out of the following
2. The level question/expected answers per OBE or the course outcomes (CO) on which the question is based is mentioned in column in front of the questions.
3. Use of non-programmable scientific calculator is allowed.
4. Assume suitable data wherever necessary and mention it clearly.

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|--|-----------|--------------|
| Q.1a) Write a brief note on the importance of unit operation in chemical process industries | CO | Marks |
| Q.1b) Give brief account of mechanical operations with any two appropriate industrial examples. | CO1 | 4 |
| Q.1c) For a sample of sand, the sphericity, density and diameter are 0.7, 2000 kg/m ³ and 700 μm respectively. Calculate the surface area of 5 kg sample. | CO1 | 4 |
| | CO3 | 4 |

- Q.2a) A crusher was used to crush a material whose compressive strength was 22.5 MN/m² the size of the feed was minus 50mm, plus 40mm and the energy required was 13.0KJ/kg the screen analysis of the product was as follows

Size of aperture [mm]	Through 6.00	On 4.00	On 2.00	On 0.75	On 0.50	On 0.25	On 0.125	Through 0.125
Mass fraction of particles	-	0.26	0.18	0.23	0.08	0.17	0.03	0.05

Calculate sauter mean diameter for above analysis. What would be the power required to crash 1kg/s of a material of compressive strength 45MN/m² from a feed minus 45mm, plus 40mm to a product of average size 0.50mm?

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| Q.2b) Discuss in brief about properties of particulate matter in bulk. | CO2 | 4 |
| Q.2c) The following table given with the size distribution of dust as follows: | CO3 | 4 |

Size rang in μm	0-2	2-4	4-8	8-12	12-16	16-20	20-24
No of particles in range	2000	600	140	40	15	5	2

- i) Calculate Sauter mean diameter
- ii) Convert these figures to obtain size distribution on mass basis and calculate specific surface assuming specific gravity of particle 2.65.

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| Q.3a) Screen analysis of a sample of galena (specific gravity= 7.43) is given below | CO3 | 4 |
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Tyler screen	3/4	4/6	6/8	8/10	10/14	14/20	20/28	-28
x (%)	3.5	15.0	27.5	23.5	16.0	9.1	3.4	2.0

Plot cumulative mass fraction and fractional mass distribution graphs.

Tyler screen	3	4	6	8	10	14	20	28
Screen size in mm	6.68	4.699	3.327	2.362	1.651	1.168	0.833	0.589

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| Q.3b) A quartz mixture having the screen analysis shown in table below through a std 10mesh screen. The cumulative analysis of overflow and underflow are given. Calculate the mass ratio of the overflow and underflow to feed and the overall effectiveness of screen. | CO4 | 4 |
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Cumulative fraction smaller than D_p

Mesh	D _p , mm	feed	overflow	underflow
4	4.699	0	0	
6	3.327	0.025	0.071	
8	2.362	0.15	0.43	0
10	1.651	0.47	0.85	0.195
14	1.168	0.73	0.97	0.58
20	0.833	0.885	0.99	0.83
28	0.589	0.94	1.00	0.91
35	0.417	0.96		0.94
65	0.208	0.98		0.975
Pan		1.00		1.00

Q.3c) Draw sketch and discuss the grizzlies considering following points CO2 4
 a) Working principles and working
 b) Advantages, disadvantages and industrial application.

Q.4a) Give brief account of following with the neat sketch, construction, working and advantages, disadvantages and industrial application. (ANY ONE) CO3 4
 a) Leaf filter
 b) vacuum filter

Q.4b) In the filtration of sludge, the initial period is affected at a constant rate with feed pump at full capacity, until the pressure difference reaches 400kN/m². The pressure is then maintained at this value for the remainder of filtration. CO4 4
 The constant rate operation requires 900 sec and one third of the total filtrate is obtained in this period. Neglecting the resistance of the filter medium, determine total filtration as well as cycle time. The time for removing cake and resembling the press is 1200 sec, the cake is not washed.

Q.4c) A cyclone separator 1 m in diameter and 3.0 m in depth has been used to handle 144,000kg/day of dust laden gas. The gas inlet is 0.3m square and gas outlet is 0.4m in diameter. If size distribution of particle (specific gravity = 1.2) in feed gas is as given below, estimate what % of particle will be separated from the gas stream. CO4 4

Particle size in μm	-11.7+8.3	-8.3+5.9	-5.9+4.2	-4.2+2.9	-2.9+2.1	-2.1
Mass fraction	0.098	0.234	0.277	0.149	0.101	0.141

Q.5a) Explain briefly the concepts of cross flow filtration. Give the classification of cross flow filtration processes according to their driving forces and separation size range. CO2 4

Q.5b) Explain the following terms in brief (any two) CO2 4
 a) molecular weight cut off
 b) observed retention and real retention
 c) osmotic pressure

Q.5c) Discuss briefly about concentration polarization in cross flow filtration. CO2 4

Q.6a) Activated sludge from secondary waste water treatment facility is to be concentrated from 2500 mg/ht to 10000 mg/lit in a continuous thickner the flow rate to the unit is 2×10^6 lit/day. Determine thickner area required from batch test data given below. CO2 6

Time, min	0	1	2	3	5	8	12	16	20	25
Height of interface, cm	51	43.5	37.0	30.8	23.0	17.9	14.3	12.2	11.2	10.7

OR

Q.6a) What are the types of Flow pattern arises in agitated vessel, how the swirling can be avoided. Discuss in brief about impellers. CO2 6

Q.6b) Give comparative study of tubular bowl and disc bowl centrifuge. CO3 6

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