**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION SP/2025)**

**CLASS: B.TECH** **SEMESTER : IV**
**BRANCH: CHEMICAL ENGG./ FOOD TECH.** **SESSION : SP/2025**

**SUBJECT: CL205R1 MECHANICAL OPERATIONS**

**TIME: 03 Hours** **FULL MARKS: 50**

**INSTRUCTIONS:**
**1. The question paper contains 5 questions each of 10 marks and total 50 marks.**
**2. Attempt all questions.**
**3. The missing data, if any, may be assumed suitably.**
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

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| | | | CO | BL |
|---|---|---|---|---|
| Q.1(a) | Differentiate between Cumulative and differential analysis | [3] | 1 | 1 |
| Q.1(b) | Highlighting the various types of equipment used for conveying solids in the chemical industry? Explain the principle of the bucket conveyor. | [4] | 2 | 2 |
| Q.1(c) | Describe the methods adopted in industry for storage of solids. Define angle of repose. | [3] | 2 | 1 |
| Q.2(a) | Explain Jaw crushers and Forces inside Ball mills in detail with figures | [5] | 3 | 2,4 |
| Q.2(b) | A milling operation has particles of three different sizes, $D_1$ = 3.327mm, $D_2$ = 2.362 mm, $D_3$ = 1.651 mm and $S_1 = 10 \times 10^{-4}\ s^{-1}$, ß = 1.3, Estimate $S_2$, $B_{2,1}$; $\Delta B_{2,1}$; $B_{3,1}$, $\Delta B_{3,1.}$ Make assumptions if required. | [5] | 3 | 5 |
| Q.3(a) | Analyze the working principles of the following devices with figures: (i) non-rotating centrifuge (ii) centrifuge used for concentration of cream from milk | [5] | 4 | 4 |
| Q.3(b) | A continuous industrial centrifuge has $q_c = 0.383\ m^3/s$ and $u_g = 0.71$ m/s. Calculate the cross-sectional area, initial slurry concentration, transport flux and settling flux of a continuous gravity settling tank having same capacity as the centrifuge. Let, total G = 10 $kg/m^2.s$, dZ/dt = 0.72 m/s. For gravity tank calculations, take $q_c$ of centrifuge as F, $u_g$ of centrifuge as u, and assume $c_o$ = c. If required assume any missing data. | [5] | 4 | 4,5 |
| Q.4(a) | Laboratory filtrations conducted at constant pressure (46196.5N/m2) on slurry of calcium carbonate in water gave the data as given below. The filter area and mass of solids per unit volume of filtrate were 0.044 $m^2$ and 23.5 $kg/m^3$. Filtration was carried out at a temperature of 25°C. Given viscosity of filtrate =0.886 cp, estimate the values of filter medium resistance and cake resistance. (Graph paper required) | [6] | 5 | 5 |

| Time, s | Filter Volume (lit) |
|---|---|
| 17.3 | 0.5 |
| 41.1 | 1.0 |
| 72.0 | 1.5 |
| 108.3 | 2.0 |
| 152.1 | 2.5 |
| 201.7 | 3.0 |

| | | | | |
|---|---|---|---|---|
| Q.4(b) | What are filter aids? How does it work during filtration? Give examples of filter aids. | [4] | 4 | 4 |
| Q.5(a) | Explain with reference to the following: (i) Discuss the separation device where reversal of flow pattern takes place (ii) Briefly discuss mechanisms of a device that produces 59% 'Cr'with 6.7% yield (iii) Elaborate the working principle of device used for high value minerals | [5] | 4 | 4 |
| Q.5(b) | Explain the working principle and construction of froth floatation with a neat diagram | [3] | 3 | 4 |
| Q.5(c) | Calculate the surface area required in an ideal settling tank to ensure removal of all discrete particles with a settling velocity of 0.0028 m/sec from a flow of 550 $m^3/h$. Determine the theoretical removal in the tank for discrete particles with settling velocity of 0.0015 m/sec. | [2] | 5 | 5 |

**::::::25/04/2025::::::M**