

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

**CLASS: BTECH
BRANCH: CHEMICAL/CHEMICAL(P&P)**

**SEMESTER : III
SESSION : MO/19**

SUBJECT: CL205 MECHANICAL OPERATIONS

TIME: 3 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. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) Discuss the advantages and disadvantages of belt conveyor. [5]
Q.1(b) The size distribution of a dust as measured by a microscope is as follows. Convert these data to obtain the distribution on a mass basis, and calculate the specific surface, assuming spherical particles of density 2650 kg/m³. [5]

Size range (μm)	0-2	2-4	4-8	8-12	12-16	16-20	20-24
Number of particles	2000	600	140	40	15	5	2

- Q.2(a) Derive the expression of critical rotational speed of ball mill. Find the critical rotational speed in rev/s for a ball mill of 1.2m diameter charged with 70 mm diameter balls? [5]
Q.2(b) Explain the different mechanism of crushing. Give example. [5]
- Q.3(a) Demonstrate the working of double cone classifier. [5]
Q.3(b) Derive the design equations of classifier and thickener. Write down the necessary assumptions. [5]
- Q.4(a) Define the cycle time (t_{cycle}) of filtration. Determine the expression for optimum cycle time of batch filtration. [5]
Q.4(b) A rotary drum filter with 30% submergence is to be used to filter concentrated aqueous slurry of CaCO₃ containing 236 kg of solids per m³ of water. The pressure drop is to be 6.9×10^4 N/m². If the filter cake contains 50% (wet basis) moisture, calculate the filter area required to filter 0.04 m³/min of slurry when the filter cycle time is 5 minute. Assume that the specific cake resistance is 2×10^{10} m/kg and filter medium resistance is negligible. The temperature is 20°C. Viscosity = 1.005×10^{-3} Pas, density = 998kg/m³. Density of CaCO₃=2700kg/m³ [5]
- Q.5(a) Demonstrate the working and applications of ESP. [5]
Q.5(b) In a mixture of quartz of density 2650 kg/m³ and galena of density 7500 kg/m³, the sizes of the particles range from 0.0052 to 0.025 mm. On separation in a hydraulic classifier under free settling conditions, three fractions are obtained, one consisting of quartz only, one a mixture of quartz and galena, and one of galena only. What are the ranges of sizes of particles of the two substances in the original mixture? [5]

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