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National Institute of Technology, Hamirpur  
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End Term Exam (November, 2023)  
CH-214 Mechanical Operation

Duration: 3 hrs

Max. Marks: 50

Note: This question paper consists of three questions and one page.

- Attempt all questions.
- Assume appropriate data wherever necessary

Q. No.	Questions	Marks
Q1.	(a) List the all type of equipment used in following operations; (i) Crushing and Grinding equipment; (ii) Handling and Transportation Equipment; (iii) Mixers, Agitators and Separators	3
	(b) A quartz mixture having a certain screen analysis is screened through a standard 10 mesh screen. Calculate: (a) the mass ratio of overflow and underflow to feed and (b) the effectiveness of the screen. Due to blinding an appreciable fraction of the screen surface becomes inactive. The blinding tendency is more pronounced with fine screens than with coarse screens.	3
	(c) Explain batch sedimentation test. Draw the graph of settling velocity and justify the graph	3
	(d) Drive the mathematical expression of settling velocity of particles in fluid with all notations and corresponding equations.	3
	(e) Explain 1-2-3-2-1-2-3-2... filtration system with neat sketch.	3
	(f) Differentiate between particulate, bubbling, and turbulent fluidization with 3 point of each and corresponding application.	3
	(g) What is minimum fluidization velocity? Explain with proper derivation.	2
2	(a) A crusher and grinder are connected to the same power drive. 2700 kg/h of limestone first passes through the crusher and then through the grinder in succession. Screen analysis of feed, product from the crusher, and product from the grinder indicated the surface areas of 2.9, 103, and 865 m <sup>2</sup> /kg respectively. Calculate the power required by the drive to run the crusher-grinder assembly, if the efficiency of the crusher is 20 % and that of the grinder is 25 % Rittinger's number for limestone is 77.4 m <sup>2</sup> /kJ.	5
	(b) What should be the diameter of a set of rolls to take feed of size equivalent to 38 mm spheres and crush to 12.7 mm?	5
3	(a) Drive the mathematical expression of the following in detail and with corresponding diagram; (i) Specific cake resistance; (ii) Filter medium resistance; (iii) Constant pressure filtration process; (iv) Constant rate and continuous filtration process	1+2+2 +3 = 8
	(b) For a sludge filtered in a washing plate and frame the filtration equation $V^2 = Kt$ holds good, where V is the volume of the filtrate obtained in time t. When the pressure is constant, 30 m <sup>3</sup> of filtrate is obtained in 10 h. (i) Calculate the washing time if 3 m <sup>3</sup> of wash water is forced to the cake at the end of filtration.; (ii) If the filtering area/surface is doubled keeping all other things constant, how long would it take to obtain 30 m <sup>3</sup> of filtrate? <b>Given:</b> The rate of washing is one-fourth the final rate of filtration.	7
	(c) A six-blade turbine agitator of diameter 60 cm is installed centrally in tank with flat bottom of diameter 180 cm, at a height of 60 cm from the bottom. The tank is filled with a solution of viscosity 10 C <sub>p</sub> and of 1.45 g/ml density. The speed of agitation is 90 rpm. The tank is baffled. Calculate the power required. <b>Data Give:</b> Power number = N <sub>p</sub> = 1.05 for N <sub>Re</sub> > 300.	5

All the Best