GWANDA STATE UNIVERSITY

FACULTY OF ENGINEERING AND ENVIRONMENT

DEPARTMENT OF METALLURGICAL ENGINEERING

PARTICULATE SYSTEMS

EMR 5201

Part V Second Semester Examination Paper

August 2022

This examination paper consists of 4 printed pages

Time Allowed: **3 hours**

Total Marks: **100**

INSTRUCTIONS

1. Answer **ALL questions in Section A and any TWO from Section B**
2. Each question carries 25 marks
3. Use of calculators is permissible

Additional Requirements

1. Calculator

MARK ALLOCATION

Section A	50 Marks
Section B	50 Marks
Part Questions	As shown in each part question
Total Attainable	100

SECTION A (50 MARKS)

ANSWER ALL QUESTIONS

Question A1

a) With the aid of a diagram, explain how shape, size and composition of gold ore particles affect its recovery by froth flotation **[8]**

b) Consider a cuboid particle having the following dimensions 5 mm x 3 mm x 1 mm. Calculate the following diameters of the particle:

i. the volume diameter **[3]**

ii. the surface diameter **[3]**

iii. the surface-volume diameter **[4]**

iv. the sieve diameter **[3]**

v. the projected area diameters **[4]**

Question A2

a) Explain using a metallurgical process of choice, three factors to be considered when selecting a filtration process **[6]**

b) Company X would like to generate energy using a fluidized bed chamber to combust coal fines. Considering the chief behaviour characteristics of the four Geldart powder groups, explain how the energy generation will be affected by the group in which the coal fines fit **[8]**

c) A sphere of diameter 10 mm and density 7700 kg/m^3 falls under gravity at terminal conditions through a liquid of density of 900 kg/m^3 in a tube of diameter of 12 mm. The measured terminal velocity of the particle is 1.6 mm/s.

i. Calculate the viscosity of the fluid. **[6]**

ii. Verify if stoke's law applies **[5]**

SECTION B (50 MARKS)

ANSWER ANY TWO QUESTIONS

Question B1

a) Distinguish between the cumulative and differential analysis of particles **[4]**

b) Outline and explain two forces that affect the motion of particles in a fluid **[6]**

c) Approximately, 3.6 kg of solid particles of density 2590 kg/m^3 and surface-volume mean size 748 mm form a packed bed of height 0.475 m in a circular vessel of diameter 0.0757 m. Water of density 1000 kg/m^3 and viscosity 0.001 Pa s is passed upwards through the bed. Calculate

i. the bed pressure drop at incipient fluidization, **[3]**

ii. the superficial liquid velocity at incipient fluidization, **[2]**

iii. the mean bed voidage at a superficial liquid velocity of 1.0 cm/s, **[4]**

iv. the bed height at this velocity and **[3]**

v. the pressure drop across the bed at this velocity. **[3]**

Question B2

a) What are the advantages and disadvantages of wet and dry screening **[8]**

b) Define sphericity and shape factor **[4]**

c) The size distribution of a dust as measured by a microscope is as follows.

i. Convert the data below to obtain the distribution on a mass basis, **[6]**

ii. Calculate the specific surface, assuming spherical particles of density 2650 kg/m^3 **[7]**

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

Question B3

a) With the aid of a diagram explain the fluidisation process **[6]**

b) For high Reynolds number (>500) flow of a fluid through a packed bed of particles how does the frictional pressure drop across the bed depend on

i. superficial fluid velocity, **[2]**

ii. particle size, **[2]**

iii. fluid density, **[2]**

iv. fluid viscosity **[2]**

v. voidage **[2]**

c) A packed bed of solid particles of density 2500 kg/m^3 occupies a depth of 1m in a vessel of cross-sectional area 0.04 m^2. The mass of solids in the bed is 50 kg and the surface volume mean diameter of the particles is 1 mm. A liquid of density 800 kg/m^3 and viscosity 0:002 Pa s flows upwards through the bed, which is restrained at its upper surface.

i. Calculate the voidage (volume fraction occupied by voids) of the bed. **[4]**

ii. Calculate the frictional pressure drop across the bed when the volume flow rate of liquid is 1.44 m^3/h. **[5]**

END OF QUESTION PAPER