Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: CH206

Course Name: FLUID AND PARTICLE MECHANICS II

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two questions. Each question carries 15 marks.
Missing data may be suitably assumed

1 a) Explain the use of a packed bed in the process industry with an example. 5

b) A packed bed of height 10 ft is employed for softening river water. The bed is composed of spherical balls of calcium hydroxide, 0.05 inches in diameter. Water, at 50^0C is fed into the inlet at a pressure of 25 kg/cm^2 with a velocity of 1 m/s. The viscosity of water may be taken as 0.5471 mPa.s and the void fraction of the bed as 0.60. Density of water may be taken as 1 g/cm^3. Calculate the outlet pressure of water exiting the bed. 10

2 a) A catalyst having spherical particles with diameter =20 mm and density = 2.8 g/cm^3 is to be used to contact a hydrocarbon vapor in a fluidized reactor at 900 ^{o}F, 1 atm. At operating conditions, the fluid viscosity is 1 cP and its density is 1 g/cm^3. Determine the range of fluidized bed operation, i.e., calculate (a) Minimum fluidization velocity for void volume fraction = 0.4, (b) The particle terminal velocity. 15

3 a) The ratio of terminal settling velocity to minimum fluidization velocity under the Stoke's law range gives a value of 50, while the ratio under Newton's law range is 8, for spherical particles in a bed with void fraction 0.45. What can you infer from this variation in ratios? Explain your inference in the practical sense. 8

b) Differentiate between particulate and bubbling fluidization. 7

PART B

Answer any two questions. Each question carries 15 marks

4 a) Explain the following terms in association with a centrifugal pump: 6

i. Zero head flow rate

ii. NPSH

iii. Priming

b) A pump draws a solution of specific gravity 1.84 from a storage tank through a pipe 9 with diameter 8 cm. Velocity in the suction pipe is 1 m/s. The pump discharges through a 5 cm pipe to an overhead tank 15 m above the level of the solution in the tank. Friction losses may be taken as 3 m of the solution. Calculate the work requirement of the pump, if its efficiency is 60%.

5 a) Draw a external gear pump. Explain the operation of gear pump. 7.5

b) Derive the expression for stagnation temperature in an adiabatic flow. 7.5

6 a) From basic equations, derive an expression for relating change in temperature of a fluid with change in its velocity while the fluid is flowing through a pipe that is insulated against heat leakage, in differential form. 10

b) Explain the practical application of property equations; pressure variation equations etc. for flow happening inside isothermal and adiabatic systems. 5

PART C

Answer any two questions. Each question carries 20 marks.

7 a) As a process engineer, you are instructed to prepare a list of agitator impellers that are suited to be used in a process that involves liquids of low to moderate viscosities. With neat figures, explain the three main types of impellers employed and their applications. 15

b) Explain the role of baffles in agitator vessels. 5

8 a) From factors of scale up, explain the scale-up procedure of agitators. 12

b) Write a method to estimate the power consumption of an agitator. 5

c) List six applications of agitators in chemical industry. 3

9 a) With figures, explain in detail the working principle of change can mixers and mixing rolls. 15

b) Explain the process of measuring mixer performance for granular non-cohesive solids. 5