Reg No.:_____ Name:_____

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

Course Code: CH206

Course Name: FLUID AND PARTICLE MECHANICS II (CH)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two questions. Each question carries 15 marks.
Assume suitable values for missing data.

1 a) Explain the variation of Reynolds number with respect to pressure drop of a packed bed. (5)

b) Develop an equation for equivalent channel diameter of a porous bed. (5)

c) Particles of sphalerite (specific gravity 4.00) are settling under the force of gravity in carbon tetrachloride (CCl_4) at 20 ^oC (specific gravity 1.594). The diameter of the sphalerite particles is 0.004 in. (0.10 mm). The volume fraction of sphalerite in CCl_4 is 0.40. Determine the settling velocity of the sphalerite. [Data: The viscosity of CCl_4 at 20 ^oC is 1.03 cP, density of CCl_4 is 99.42 lb/ft^3, density difference $\rho_p - \rho = 150.06$ lb/ft^3] (5)

2 a) Explain the term fluidisation. Derive an equation for minimum fluidisation velocity. (5)

b) A bed of ion-exchange beads 8 ft deep is to be backwashed with water to remove dirt. The spherical particles have density of 1.24 g/cm^{3}and an average size of 1.1 mm. What is the minimum fluidisation velocity using water at 20 ^oC, and velocity required to expand the bed by 30 percent? ε_M is taken as 0.40. (10)

3 a) Water is pumped upward through a bed of 1 mm diameter iron oxide particles (SG = 5.3). If the bed porosity is 0.45, over what range of superficial water velocity will the bed be fluidized? (15)

PART B

Answer any two questions. Each question carries 15 marks

4 a) Explain cavitation and method to avoid cavitation. Obtain an expression for Net Positive Suction Head (NPSH) (5)

b) Outline the theory of compressor by explaining the work done on an isothermal and adiabatic compressor. (5)

c) A three stage reciprocating compressor is to compress 180 std ft^3/min (306 m^3/h) (5)

of methane from 14 to 900 lb/in^2 (0.95 to to 61.3 atm) abs. The inlet temperature is 80 ^{0}F (26.7 ^{0}C). For the expected temperature range the average properties of methane are

Cp=9.3 Btu/lb mol. ^{0}F (38.9J/g mol. ^{0}C), Υ =1.31

i) Determine the brake horsepower if the mechanical efficiency is 80%.

ii) Determine the discharge temperature from the first stage.

5 a) For steady isentropic flow, if the density doubles, by what ratio does the static pressure increase? (5)

b) Develop an equation for temperature in isentropic flow from a reservoir to a circular duct. Assume frictionless flow. (10)

6 a) Air enters a convergent-divergent nozzle at temperature of 555.6 K and a pressure of 20 atm. The throat area is one-half that of the discharge of the divergent section. (7.5)

(i) Assuming the Mach number in the throat is 0.8, determine the values of the following quantities at the throat: pressure, temperature, linear velocity, density and mass velocity.

(ii) Determine the values of p*, T*, u* and G* corresponding to reservoir conditions.

(iii) Assuming the nozzle is to be used supersonically, determine the maximum Mach number at the discharge of the divergent section.

For air Υ = 1.4, R = 287, and M = 29.

b) The head of a centrifugal pump is a function of impeller diameter, impeller speed, and velocity of fluid leaving the impeller. The head is not a function of density. If a pump is having a head of 20 m, why air blocks become significant? Predict a solution for air block. (7.5)

PART C

Answer any two questions. Each question carries 20 marks.

7 a) Explain rheological behaviour of non-Newtonian fluid (5)

b) Define flow number with suitable equation (5)

c) A pilot -plant vessel 0.3 mm in diameter is agitated by a six-blade turbine impeller 0.1 min diameter. When the impeller Reynolds number is 10^4, the blending time of two miscible liquids is found to be 15 s. The power required is 0.4 kW/m^3 of liquid. (a) What power input would be required to give the same blending time in (10)

a vessel 1.8 m in diameter? (b)What would be the blending time in the 1.8 m vessel if the power input per unit volume were the same as in the pilot-plant vessel?

8 a) If an engineer wants to use two turbines on the same shaft, what is the criterion to be followed? (5)

b) Explain the working of the following: (15)

(i) Muller Mixers

(ii) Change can mixer and kneaders.

(iii)Dispersers and masticators.

9 a) Explain mixer-extruders (5)

b) Explain the working of the following: (10)

(i) Ribbon mixer with a diagram

(ii) Tumbling mixer

c) Define mixing efficiency and axial mixing. (5)