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| **Scheme of Valuation/Answer Key**  (Scheme of evaluation (marks in brackets) and answers of problems/key) | | | | | | |
| **APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  **FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2019** | | | | | | |
| **Course Code: CH206** | | | | | | |
| **Course Name: FLUID AND PARTICLE MECHANICS II (CH)** | | | | | | |
| Max. Marks: 100 | | |  | Duration: 3 Hours | | |
| If not specified, wherever calculations are involved the marks may be distributed as: equation – 60%, substitution-30%, answer with proper unit-10% If not specified, wherever derivation are involved the marks may be distributed as: explanation and units of the terms – 40%, steps-50%, final form 10% | | | | | | |
| **PART A** | | | | | | |
| ***Answer any two questions. Each question carries 15 marks.*** | | | | | | |
| 1 | a) | Ranges of Reynolds number with Kozeny Carman,Burke-Plummer and Ergun equation.  Ergun equation with Reynolds number format and explanation (*alternate answer*) | | | | 5 |
|  | b) | Derivation of Deq with figure  *Any method shall be used* | | | | 5 |
|  | c) | acceleration of gravity (g)=9.81 m/s2  particle diameter (d)=1 x 10-4 m  density of particle (ρp)= 1.594 g/cm3 = 1594 kg/m3  density of medium (ρm) = 99.42 lb/ft3 = 1592.6 kg/m3  viscosity of medium (μ)= 0.0103 g/ms  shape of the particles – sphere assumed (1)  and  Criterion for settling regime, K value(1)  ut value= 0.01216 m/s(2)  Or  Assume the range of NRe, and select an appropriate equation ut value= 0.01216 m/s (2)  Find NRe, and confirm the assumption. (1)  and  hindered settling velocity shall be calculated if any correlation is provided (1) | | | | 5 |
| 2 | a) | Fluidisation definition- explantion with velocity vs height and void fraction vs velocity. (2)  Minimum fluidisation velocity derivation considering either Kozeny Carman equation or Burke Plummer Equation (3) | | | | 5 |
|  | b) | acceleration of gravity (g)=9.81 m/s2  particle diameter (dp)=1.1 x 10-3 m  density of particle (ρp)= 1240 kg/m3  density of medium (ρf) = 1000 kg/m3  viscosity of medium (μ) = 0.01 g/ms  void volume fraction, ε = 0.40  shape of the particles – sphere *assumed*  Sphericity = 1 (1)  Calculation of pressure drop = 3500 ± 2000 N (2) (The mark for this step shall be added to next step if pressure drop is not calculated)  Calculation of Minimum fluidization velocity using either Ergun Equation or Kozeny Carman Equation  Minimum fluidization velocity V0M = 0.002 ± 0.0008m/s (3)  Rep= 2.65 (1) (The mark for this step shall be added to previous step if Ergun equation is used)  New void volume fraction, ε = 0.54 (1)  pressure drop = 3500 ± 2000 N (1)  Calculation of superficial velocity using either Ergun Equation or Kozeny Carman Equation  V0= 0.006 ± 0.0005 m/s (1) | | | | 10 |
| 3 | a) | acceleration of gravity (g)=9.81 m/s2  particle diameter (d)=1 x 10-3 m  density of particle (ρp)= 5000 kg/m3  density of medium (ρm) = 1000 kg/m3  viscosity of medium (μ) = 0.01 g/ms  void volume fraction, ε = 0.45  shape of the particles – sphere *assumed*  Sphericity = 1 (2.5)  and  Criterion for settling regime, K value (2)  ut value= 234 ± 100 m/s (3)  Or  Assume the range of NRe, and select an appropriate equation ut value= 234 ± 100 m/s (3)  Find NRe, and confirm the assumption. (2)  And  Calculation of pressure drop per unit length = 23200 ± 1000 N/m (2) (The mark for this step shall be added to next step if pressure drop is not calculated)  Calculation of Minimum fluidization velocity using either Ergun Equation or Kozeny Carman Equation  Minimum fluidization velocity = 0.47 ± 0.1 m/s(3) | | | | 15 |
| **PART B** | | | | | | |
| ***Answer any two questions. Each question carries 15 marks*** | | | | | | |
| 4 | a) | Definition of cavitation (1)  Method to avoid cavitation (1)  Derivation for NPSH (3) | | | 5 | |
|  | b) | work done on an isothermal compressor  work done on an adiabatic compressor | | | (2.5)  (2.5) | |
|  | c) | Pb/Pa= 4  PB= 26 ± 1 hp  Tb= 290 ±5 oF | | | (1)  (2)  (2) | |
| 5 | a) | Explanation (relation between density and pressure *i.e.* P/ργ=constant) (2)  Assuming γ value and suggesting the final form- (3)  (If ideal gas equation P/ρ=constant is assumed give 2 marks) | | | 5 | |
|  | b) | Develop an equation for temperature in isentropic flow from a reservoir to a circular duct. Assume frictionless flow.  explanation and units of the terms – (4)  steps-(5),  final form (1) | | | 10 | |
| 6 | a) | (a)pt= 13.12 ± 0.2atm,  ρt=9.41 ± 0.2 kg/m3, (2)  ρ0= 12.72 ± 0.2kg/m3,  ut=355.7 ± 5m/s  Gt=3348 ± 50kg/m2.s ,  Tt=492.5 ± 5 K(4)  (b)p\*=10.56 atm, T\*=463K, ρ\* =8.06kg/m3, G\*=3476 kg/m2.s(1)  (c) Ma=2.20(0.5) | | | 7.5 | |
|  | 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.  Air pressure = 20\*10\*1=200 Pa = 0.002 atmapproximately(3)  So no enough pressureto displace the air from the volute to atmosphere or outlet pressure. So pump can be used to for any liquid which generate a pressure greater than outlet pressure/atmosphere (3)  (The above statement is interpreted from McCabe, W.L., Smith, J.C. and Harriott, P., 1993. *Unit operations of chemical engineering* (Vol. 1130). New York: McGraw-Hill. Kindly refer)  Priming(1.5) | | | 7.5 | |
| **PART C** | | | | | | |
| ***Answer any two questions. Each question carries 20 marks.*** | | | | | | |
| 7 | a) | Rheological behaviour of non-Newtonian fluid | | | (5) | |
|  | b) | Definition of flow number  Equation | | | (3)  (2) | |
|  | c) | Diameter of vessel, D = 0.3 mm  Diameter of turbine, Di = 0.1 mm  Reynolds number NRe = 104  blending time of two miscible liquids, tr = 15 s  power required,P = 0.4 kW/m3 (3)  and  Assuming that the original vessel is a standard cylinder with D = H =0.3m. So Df = Hf =1.8 m. Then scale-up ratio R =1.8/0.3=6.  scale-up agitator speed Nf = N/R, N not specified. Ntr = F(NRe)  Power no Np calculation require correlation or charts.  So, data is missing. The values can’t be estimated. (7)  Or  (a) Power input=14.4 kW/m3(3)  (b) Blending time= 49.5 s (4) | | | 10 | |
| 8 | a) | Explanation for distance between two impeller and impeller diameter. (4)  Distance between two impellers might be equal to impeller diameter for less power consumption. (1) | | | 5 | |
|  | b) | Explanation of   1. Muller Mixers(5) 2. Change can mixer and kneaders. (5) 3. Dispersers and masticators. (5) | | | 15 | |
| 9 | a) | Explanation of mixer-extruders  Figure | | | (4)  (1) | |
|  | b) | Discuss Briefly   1. Ribbon mixer   Figure.   1. Tumbling mixer   Figure. | | | (4)  (1)  (4)  (1) | |
|  | c) | Definition of mixing efficiency (2.5)  Definition of axial mixing with figure. (2.5) | | | 5 | |