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M. Sc. (Industrial Chemistry), Second(2nd) Semester Examination(NC)

November - 2017

PS02CICH09—Heat Transfer Operations and Stoichiometry

Wednesday, 1-11-2017

Time: 10:00a.m. to 01:00 p.m. **Total Marks: 70**

Note: i) Attempt all the questions.
ii) Figures to right indicate full marks.
iii) Draw neat diagrams wherever it requires.

Q-1 **Answer the following Multiple Choice Questions.** **Marks (08)**

1. Fins serve the purpose of____

   a) decreasing heat transfer ratec) decreasing heat transfer area
   b) increasing heat transfer rated) increasing thermal conductivity

2. Double pipe heat exchanger falls under the category of_____
   a) regenerators c) recuperators
   b) evaporatorsd) All of these

3. Heat flow through building wall is an example of _____.
   a)conduction c) convection
   b) radiation d) evaporation

4. LMTD cannot be used without correction factor for a_____.
   a)multipass shell & tube heat exchanger
   b) single pass double pipe heat exchanger
   c) single pass shell & tube heat exchanger
   d) none of these

5. Which is most suitable for the evaporation of cold viscous feed?

   a) forward feed c) mix feed
   b) backward feed d) parallel feed

6. The unit of heat transfer co-efficent is_____

   a) Kcal/hr m^2K c) Kcal/hr K
   b) Kcal/hrmK d) Kcal/hr m

7. The component which is present in more than its stoichiometric proportion with respect to other reacting components is called____
   a) Excess reactantc) limiting reactant
   b) stoichiometric reactant d) none of these

8. The ratio of moles of desired product formed to moles of undesired product formed is called_____.

   a) selectivityc) yield
   b) molarity d) mole ratio

Q-2 Answer the following short questions. Each question carries equal mark.(**Any Seven**) **(14)**

1. Distinguished between individual and overall heat transfer co-efficent.
2. Why are tie rods and spacers used in heat exchanger?
3. Define black body.
4. Distinguished between the various modes of heat transfer.
5. What is Fourier's law of conduction?
6. Define the tem NTU used in heat exchanger calculations.
7. Enlist the important requirements of insulating materials.
8. Define selectivity and yield of reaction?
9. Why are radiation shield used?

Q-3 (a) With the help of neat diagram explain the working of a double pipe heat exchanger.. **(06)**

Q-3 (b) A pipe of 0.15 m dia& 1 m length and at temperature of 573 K is covered with 2 layers of insulation. The first layer is of 0.05 m thick with a k value of 0.062 W/m K and the second layer is 0.06 m thick with a k value of 0.8 W/m K. The outer surface of second layer covering is at a temperature of 330 K. **(06)**
Calculate the heat loss and the interface temperature.

OR

Q-3 (b) With the help of neat diagram explain the working of a shell and tube heat exchanger. **(06)**

Q-4 (a) Calculate the surface area required for a heat exchanger which has to cool 55,000 kg/hr of alcohol from 66^0C to 40^0C using 40,000 kg/hr water entering at 5^0C. **U** based on outer tube area is 2088 kJ/hr m^2K. Cp of alcohol = 3.76 kJ/kg K and that of water is 4.18 kJ/kg K. **(06)**

Consider parallel S&T Exchanger.

Q-4 (b) A fluid (Cp = 3.3 kJ/ kg K) flowing at 20,000 kg/hr enters a parallel flow heat exchanger of 40% efficiency at 120^0C. Water (Cp = 4.186kJ/ kg K) flowing at 50,000 kg/hr which is used as the coolant enters at 20^0C. If a heat transfer area of 10 m^2 is available, What will be the heat transfer co-efficient. **(06)**

OR

Q-4 (b) An oil (Cp = 3.3 kJ/ kg K) flowing at 20,000 kg/hr& 120^0C is cooled in single pass parallel flow S&Theat exchanger using cooling water (Cp = 4.18 kJ/ kg K) flowing at 50,000 kg/hr and 20^0C. There are 159 tubes each of length 2 m and OD 0.01 m and the overall heat transfer co-efficient (U_0) is 3780 kJ/hr m^2K. **(06)**
Find the LMTD using NTU method.

Q-5 (a) A tray drier is fed with 1000 kg of wet orthonitro aniline containing 10% water the dried product contains 98.5% ortho nitro aniline and rest is water. **(06)**
Find the percentage of water removed.

Q-5 (b) 100 kg of a solution containing 55% benzene, 28% toluene and 17% xylene by weight is in contact with its vapor at 373 K. Calculate the total pressure and molar composition in liquid phase. **(06)**

	Benzene (MW-78)	Toluene (MW-92)	Xylene (MW-106)
Vap. Pr. (kpa)	178.6	74.6	28

OR

Q-5 (b) A combustionreactor is fed with 50 kmol/hr of butane and 2000 kmol /hr of air. **(06)**

$C_4H_{10} + 6.5O_2 \longrightarrow 4CO_2 + 5H_2O$

Calculate the % excess air and composition of gases leaving the combustion reactor assuming complete combustion.

Q-6 (a) Calculate the heat needed to raise the temperature of 17 kg ammonia from 311 K to 422 K. **(06)**

Cp of NH_3 between 311 K – 298 K = 35.8641 kJ/k mol K

Cp of NH_3 between 422 K – 298 K = 37.7063 kJ/k mol K

Q-6 (b) Calculate the change in enthalpy beween reactants and products of the given reaction if both reactants and products if both are at 298 K when 5 kmol ethylene oxide produced. **(06)**

$C_2H_4 + ½\ O_2 \longrightarrow C_2H_4O$

	ΔH_f (kJ / mol)
C_2H_4	52.5
C_2H_4O	-52.63

OR

Q-6 (b) 1 kmol of pure A is heated from 303 K to 523 K. Calculate the heat added using the Cp (kJ/ k mol K). Data as below: **(06)**

a	4.1261
b	155.02×10^{-3}
c	-81.545×10^{-6}
d	$16.975\ 10^{-9}$

All the Best!

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