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MMTP - 202

M.E./M.Tech., II Semester

Examination, June 2014

Design Of Heat Exchangers

Time : Three Hours

Maximum Marks : 70

Note : i) Solve any five questions.

ii) All questions carry equal marks.

1. a) On the basis of different criterias how Heat Exchangers are classified?

   b) Discuss concept of fouling? How fouling affects the heat exchangers performance?

2. Draw a schematic diagram of a Heat pipe and discuss the operation and working of a heat pipe, what are the applications of heat pipe in engineering?

3. A concentric tube heat exchanger is used to cool the lubricating oil for a large marine engine. The inner tube is constructed from 2 mm wall thickness stainless steel (R = 16 W/m.K). The flow rate of cooling water through the inner tube (r_i = 30mm) is 0.3 Rg/s. The flow rate of the oil through outer tube (R_i = 50mm) is 0.15 Rg/s. Assuming fully developed flow and taking fouling resistances on oil side as 0.0004 m^2.k/w and on water side as 0.0001 m^2.k/w. Calculate the overall heat transfer coefficient referred to inside surface. Use properties of oil at 80°C and water at 35°C.

4. A shell and tube type heat exchanger is to heat 10,000 kg/h of water from 16°C to 84°C by hot engine oil flowing through a shell. The oil makes a single shell pass, entering at 160°C and leaving at 94°C, with an average heat transfer coefficient of 400 $W/m^2.k$. The water flows through 11 brass (R = 100 W/m.k) tubes of 22.9 mm inside diameter and 25.4 mm outside diameter, with each tube making four passed through the shell. Assume fully developed flow for the water, determine the required tube length per pass.

5. In a heat exchanger, hot fluid enters at 180°C and leaves at 118°C. The cold water enters at 99°C and leaves at 119°C. Find the LMTD, NTU effectiveness in the following cases of heat exchanger.
   i) Counter flow
   ii) One shell pass and multiple tube passes
   iii) Two shell passes and multiple tube passes
   iv) Cross flow both fluids unmixed and
   v) Cross flow, the cold fluid unmixed

6. Exhaust gas from a furnace is used to preheat the combustion air supplied to the furnace burners. The gas, which has a flow rate 15 Rg/s and an inlet temperature of 1100 k, passes through a bundle of tubes, while the air, which has a flow rate of 10 Rg/s and an inlet temperature of 300 k, is in cross flow over the tubes. The tubes are in finned, and the overall heat transfer coefficient is 100 $W/m^2.k$. Determine the total tube surface area required to achieve an air outlet temperature of 850K. The exhaust gas and air may each be assumed to have a specific heat of 1075 J/Rg.K.

Use the following relation

$\varepsilon = (1/C)\,(1-\exp\{-C[1-\exp(-NTU)]\})$

Where C = ratio of two specific heats = c min/c max.

NTU = Number of Transfer Units.

ε = effectiveness of the heat exchanger.

7. Consider a finned tube compact heat exchanger having the core configuration of fig. 14.57. The core is fabricated from aluminium (R=237 W/m.k) tubes have an inside diameter of 13.8 mm. In a waste heat recovery applications, the water flow through the tubes provides an inside convection coefficient of 1500 $W/m^2.k$, while the combustion gases at 1 atm and 700k are in cross flow over the tubes. If the gas flow rate is 1.25 Rg/s and the frontal area is 0.2 m^2, what is the overall heat transfer coefficient based on gas side. Take fin efficiency as 0.89.

8. Write short notes on following:
   a) TEMA codes.
   b) Design of air washers
   c) Use of softwares in Heat Exchanger design
   d) Micro Heat Exchangers.

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