Total No. of Questions :8] *[Total No. of Printed Pages :3*

Roll No .....

MMTP - 202

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

Examination, December 2013

Design of Heat Exchangers

Time : Three Hours

Maximum Marks : 70

Note: Solve any five questions.Heat and Mass transfer data book is permitted in examination hall.

1. A Automobile radiator may be viewed as a cross flow heat exchanger with both fluid unmixed. Water with a flow rate of 0.05kg/s enters at 400K and leaves at 330K. The water is cooled by air which enters at 300K with a Flow rate of 0.75 kg/s. If the overall heat transfer coefficient is 200 W/m 2K. Find the required heat transfer area.

2. Being a heat exchanger designer you are interested to design a shell and tube type heat exchanger which will be used to heat 3Kg/s of water from 15°C to 85°C by hot engine oil flowing through the shell of the exchanger. The oil making a single pass enters the exchanger at 160°C and leaves at 100°C. The average heat transfer coefficient of oil side outside the tubes is 400 W/m^{2}k. To accomplish this heating ten tubes are used to pass the water through the shell, each tube is thin walled of diameter 25mm and makes eight passes through the shell. Calculate the Flow rate of oil and length of the tube and shell to accomplish the desired heating.

3. A cross flow heat exchanger is to heat water with hot exhaust gases. The exhaust gas specific heat 1.05kJ/kg.k. enters at 200°C with mass flow rate of 2.5kg/s while water enters at 30°C with a flow rate of 1.5kg/s. The overall heat transfer coefficient is 150 W/m^{2}K. Calculate total heat transfer rate and outlet temperature of two fluids. Take heat transfer area as 17.5m^2.

4. Hot exhaust gases are used in a shell and tube heat exchanger to heat 2.5Kg/s of water from 35°C to 85°C. The gases assumed to have the properties of air enters at 200°C and leaves at 93°C. The overall heat transfer coefficient is 180W/m^{2}K. Using NTU method. Calculate the area of heat exchanger.

5. Fresh water from an engine is to be cooled from 68°C to 54°C with sea water available at 32°C. A plate heat exchanger is fabricated from 0.5mm thick, 2m high, 1m wide, type 304 stainless steel plates with a gap of 5mm between the plates. Fresh water enters the heat exchanger at 68°C with a mean velocity of 0.5m/s between the plates. Sea water enters the heat exchanger at 32°C with a mean velocity of 0.5m/s.

   The Fluids flow in opposite direction parallel to the 2m dimension. Determine the overall heat transfer coefficient, the heat transfer rate across each plate, and the exit temperature of each liquid.

6. Steam at atmospheric pressure enters the shell of a surface condenser in which the water flows through a bundle of tubes of diameter 30mm at the rate of 0.06 kg/s. The water enters the condenser at 20°C and leaves at 75°C. Steam condenser on the outside surface of the tube. The overall heat transfer coefficient is expected to be 250W/m^{2}k. Using NTU method, Calculate the effectiveness, length of the tube and steam condensation rate. Assume that only latent heat of steam is lost during condensation. Take the latent heat of vapourisation at 100°C, h_{fg} = 226/kJ/kg.

7. Draw a neat well nomenclated diagram (adapted from TEMA) of floating head shell and tube type heat exchanger with two tube passes and one cross baffled shell pass write functions of following parts of above heat exchanger:-
   a) Shell nozzle
   b) Floating Head
   c) Floating Head backing device
   d) Channel nozzle
   e) Tie rods and spacers
   f) Transverse baffles or support plates.
   g) Impingement baffle
   h) Vent connection
   i) Support saddles
   j) Lifting ring

8. Write short notes on followings:
   a) TEMA codes and their applications in design of Heat Exchangers
   b) Micro Heat Exchangers
   c) Design of Air Washers
   d) Testing and Inspection of Heat Exchangers
   e) Heat pipes

******