Department of Mechanical Engineering
Indian Institute of Technology New Delhi
II Semester – 2006 - 2007

ME709   HEAT EXCHANGERS

<u>MAJOR EXAMINATION</u>

Note: Open (Your own) hand written notes Examination. Property tables & tutorial sheets are allowed.

Time : **2 HOURS**   Max. Marks: **60**

Problem 1 :

Prove that a High Pressure Colsed Feed water heater is a combination of three shell and tube heat exchangers.

A power plant turbine is working with an inlet steam flow rate of 1500 *tons/hr*. First bleed steam is taken at a pressure of 5 *MPa* and 320 °C. The mass flow rate of bleed steam is 10% of the inlet steam flow rate. The condesed bleed water leaves the HP Closed Feed Water Heater at a temperature of 250°C. The feed water enters HP CFWH at a temperature of 235 °C. Compute temperatures of steam and feed water across desuperheater , condenser and drain-cooler. Also compute following parameters of these three exchangers.

(a) LMTD of each part.

(a) Capacities of each part.

(a) Approximate sizes (in percentage of heat exchanger area) of each part.

Finally design the de-superrheater only (neglect the thermal resistance of tube material). Following steam properties are recommended.

Specific heat of steam : 3.32 kJ/kgK.

Kinematic viscosity of steam : $56.6 \times 10^{-6} m^2/s$.

Thermal diffusivity : $0.0422 W/m.K$.

                                                                                                20 marks

Problem 2 :

Define NTU for an air water system and Derive an expression for NTU in terms of enthalpy difference.

                                                                                                15 marks

Problem 3 :

Hot exhaust gas (2200 *tons/hour*) is flowing past a superheater bundle at a temperature of 1000 K. The steam is flowing through the tube bundle at a flow rate of 1450 *tons/hour*. The pressure and inlet temperature of the steam are 18 MPa and 475 °C. The total capacity of the super heater is 120 MW. It is estimated that the overall heat transfer coefficient of the super heater is 125 W/m^2K. Average properties of gas and steam are given below:

Specific heat of exhaust gas : 1.17 kJ/kgK.

Specific heat of steam : 3.65 kJ/kgK.

Calculate number of tubes and overall dimensions of superheater.

                                                                                                15 marks

Problem 4 :

Derive an expression for variation of temperature of fluid flowing through a tube in a multi-pass heat exchanger.

                                                                                                10 marks