$$\frac{1}{U} = 0.08 + \frac{1}{h} = 0.08 + \frac{1}{(0.4V)}$$

$N = (AD^2/4)/160 = 0.0005\,D^2$

Where N = No. of tubes

m = No. of tube passes

V = Velocity in m/sec

U = Overall heat transfer coefficient in kW/m^2k

h = Convective heat transfer coefficient in kW/m^2k

D = Sheet diameter and

L = Tube length in m

The pressure drop of tube fluid per m length of tube, kP/m, in $0.1\,V^2$. The optimum heat exchanger is one of least cost that meets the other requirement and cost is a function of L and D. Develop the constraints in terms of L and D.

8. Write short notes on any two:
   a) Numerical computation technique for continuous model.
   b) Computer aided design material selection.
   c) Genetic Algorithm.

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Roll No ....

MMTP-301(A)

M.E./M.Tech., III Semester

Examination, December 2014

Computer Aided Design of Thermal System

(Elective - I)

Time : Three Hours

Maximum Marks: 70

Note : Attempt any five questions. All questions carry equal marks. Assume suitable missing data, if any.

1. Discuss the basic elements of thermal system design. What do you mean by formulation of design problem? Explain with an example.

2. a) What is modelling? Differentiate between physical and conceptual modelling. Explain with example.

   b) What is the maximum rate of heat transfer possible in a counter flow heat exchanger show below if the water enter at 30° and cools oil entering at 60°C.

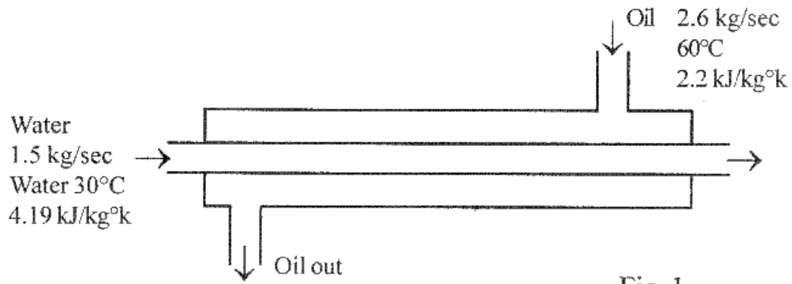

Fig. 1

3. In a processing plant, a material must be heated from 20°C to 80°C in order for desired reaction to proceed, where upon the material is cooled in a regenerative heat exchanger as shown in figure 2. If the UA of heat exchanger is 2.1 kW/k and flow rate 1.2 kg/sec. Find out the temperature + leaving the heat exchanger.

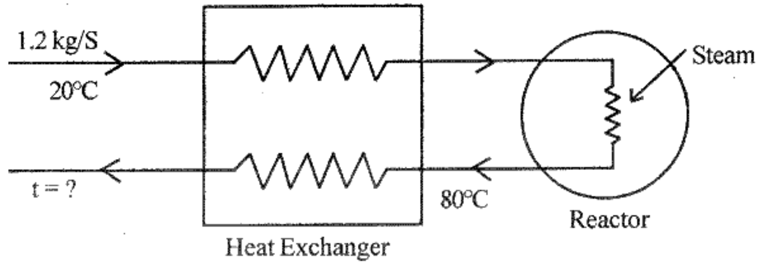

Fig. 2

4. a) What do you understand by system simulation? Differentiate between with examples.
   i) Continuous or discrete.
   ii) Deterministic or stochastics.
   iii) Steady state a dynamic.

   b) How is simulation of a queuing system done?

5. A two stage air compressor with intercooler shown in figure 3. Compressor dry air from 100 to 1200 kPa absolute. The displacement rate of low stage and high stage compressors are 0.2 m³/sec and 0.05 m³/sec respectively.

The volumetric efficiency

$$\eta = \frac{\text{Flow rate measured at compressor suction } (m^3/sec)}{\text{Displacement rate } (m^3/sec)} \times 100$$

and for both compressors

$$\eta\% = 104 - 4.0\left(\frac{P_{discharge}}{P_{suction}}\right)^{1.4}$$

The polytropic exponent h is 1.2. The intercooler in a counter flow heat exchanger receiving 0.09 kg/sec of water at 22°C. The product of overall heat transfer coefficient and area of heat exchanger is 0.3 kW/k. Use Newton-Raphson method to simulate the system. Determining at least the value of ω_1 p_1, t_2 and t_3. Limit the number of its ratio to 10.

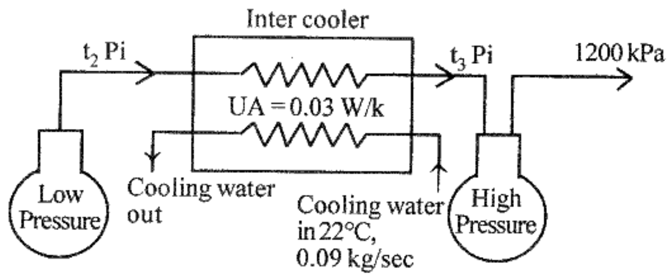

Fig. 3

6. What is optimization? Discuss different optimization methods.

7. An optimum shell and tube heat exchanger has a UA value of 1500 KW/K and has a pressure drop of the tube fluid of 300 kPa. Applicable equations are

$A = 0.2\,NL$, $V = 5\,m/N$