

Ques 10

Soln

$$Q = \dot{m}_h \cdot C_{ph} (T_{h,in} - T_{h,out})$$

$$Q = 3 \times 2300 (150 - 55)$$

$$Q = 655.5 \text{ kW}$$

~~Step~~ Cold water temp at exit

$$Q = \dot{m}_c \cdot C_{pc} (T_{c,out} - T_{c,in})$$

$$655500 = 3 \times 4180 (T_{c,out} - 20)$$

$$52.27 = T_{c,out} - 20$$

$$T_{c,out} = \underline{72.2727}^\circ \text{C}$$

$$\Delta T_{lm} = \frac{(T_{h,in} - T_{c,out}) - (T_{h,out} - T_{c,in})}{\ln \left( \frac{T_{h,in} - T_{c,out}}{T_{h,out} - T_{c,in}} \right)}$$

$$= \frac{(150 - 72.27) - (55 - 20)}{\ln \left( \frac{150 - 72.2727}{55 - 20} \right)}$$

$$= \underline{123.3115}^\circ \text{C}$$

Now

The correction factor for 2 shell pass & 20 tube pass

$$R = \frac{T_{in} - T_{out}}{T_{out} - T_{in}}$$

$$= \frac{150 - 55}{72.72 - 20} = \underline{1.802}$$

$$P = \frac{T_{out} - T_{in}}{T_{in} - T_{in}} = \frac{72.72 - 20}{150 - 20} = \underline{0.405}$$

The correction factor for two shell pass & 20 tube passes, correction factor charts at

$$P = 0.405 \text{ \& } R = \underline{1.802}$$

$$F = 0.34$$

Now Heat transfer surface area

$$Q = FUA\Delta T_m$$

$$655500 = 0.94 \times 350 \times A_s \times 123.3115$$

$$\boxed{A_s = 16.157 \text{ m}^2} \quad \underline{\underline{K}}$$