REVIEW SET 3 work before class on December 3, 2008

Note – will not be collected or graded = self correct during class.

NAME :_____

Ch. E. 453 November 30, 2007

EXAM NO. 3

Open Book and Notes

(40 points)

1. Three gallons per minute (3.0 GPM) of anhydrous ethanol are to be piped from a storage tank to a vegetable oil esterification reaction vessel to manufacture Biodiesel. Maximum pressure in the piping system will not exceed 120 PSIG and the pipeline will be 105 feet long and fabricated from type 304 stainless-steel welded pipe. The fluid properties at the operating temperature (30 °C) are **:**

Specific Gravity = 0.791 Density = **49.36** Lb/Ft^3 = **790.6** kg/m^3

Viscosity = 1.05 centipoises = **0.00105** Pascal - seconds

Thermal conductivity = 0.105 $Btu/hr\,ft^2\,°F/ft$ = 0.596 $W/m^2\,K$

a) **Recommend an optimum theoretical pipe size for the design.**

b) **Recommend the optimum practical pipe size for the design.**

c) **Determine the 3rd Quarter 2007 (** M&S = 1,393.0 **) purchased cost of the recommended practical design pipeline materials.**

CLEARLY STATE and **JUSTIFY ALL ASSUMPTIONS** and **EXPLAIN your reasoning.**

(20 points)

2. In order to **maximize yield** during the transesterification of rapeseed oil into ethyl esters for use as biodiesel, the EVOP optimization technique is being used. Excess ethanol is reacted with rapeseed oil in the presence of a catalyst. The independent process control variables are reactor temperature, excess alcohol rate, and catalyst concentration. The following experimental results have been obtained:

% Catalyst concentration	% Excess Alcohol	°F Temperature	Measured % Yield
0.9	94	100	92.2
0.95	100	100	90.9
0.95	97	120	90.7
1.0	94	100	88.8
0.95	100	100	89.3
0.9	94	100	90.7
1.0	94	100	90.3
0.9	94	100	89.7
0.95	97	120	90.5
1.0	94	100	89.6
0.9	94	100	94.0
1.0	94	100	92.1
0.95	100	100	93.4
0.95	100	100	89.3
0.95	97	120	90.9
0.95	97	120	91.6

Determine the conditions for the next experiment to be conducted.

(40 points)

3. The Vandal•Con Company board of directors uses **discounted cash flow rate of return** as their profitability criteria. They are considering a 2 year project proposal whose after tax cash flows are specified in Table 3**:**

Table # 3

End of Year	Proposal **C**	
0	-$78	(initial investment)
1	$210	(1st year annual profit)
2	$230	(2nd year annual profit)

Use a ***GOLDEN SECTION SEARCH*** between 5% and 300% to **determine discounted cash flow rate of return {DCFR** *or* **IRR} to the nearest 25%.** Conduct **6** iterations of the Golden Section Search and make a recommendation on the rate of return.

Clearly state the equation you are going to optimize before starting the search.