

## SysEng 6103 Systems Life Cycle Costing - Summer 2020

### Midterm Exam

Assigned: June 24, 2020

Due: July 1, 2020 until midnight CST

**Remark 1:** This is an individual exam, no collaboration is allowed.

**Remark 2:** Please show all your work and reasoning, as partial credit may be given for certain problems for legible, but inaccurate work. If I cannot easily decipher your work, it will be marked wrong.

**Remark 3:** The total of 100 points are distributed as shown in brackets before the questions.

Question:	1	2	3	4	Total
Points:	25	25	25	25	100

#### Submission Guidelines

- Submissions should be in PDF file format for some questions/parts, and in Microsoft Excel file format for others (indicated on the question/part line in bold letters). Both files (1 pdf, 1 Excel file with multiple sheets for each relevant question and part) should be submitted through Canvas, before the due date and time.
- Filenames should start with the course code, your own name and a reference to the assignment, such as "SysEng6103\_Doe\_Jane\_MidtermExam..."
- Use 1 Excel sheet per 1 exercise, and label sheet tabs with: Exercise#, and highlight answers in the sheet.

1. \_\_\_\_\_ [25 points]

**[Include in the Excel file only. Prepare a cash-flow (CF) table, and then, use Goal Seek in Excel to find the unknown interest rate. Remark: Do not forget to put before and after snapshots of Goal Seek function since Goal Seek does not retain any information, and therefore, I have no way to check your work otherwise.]**

A start-up company that makes robotic hardware for CIM (computer integrated manufacturing) systems borrowed \$1 million to expand its packaging and shipping facility. The contract required the company to repay the lender through an innovative mechanism called *faux dividends*, a series of uniform annual payments over a fixed period of time. If the company paid \$290,000 per year for 5 years (i.e., years 1 through 5), what was the interest rate on the loan?

2. \_\_\_\_\_ [25 points]

**[Include in the PDF file only. Set up an annual worth (AW) relation to calculate the breakeven point using factor notation, and then, solve the AW relation by hand using interest factor table.]**

An effective method to recover water used for regeneration of ion exchange resins is to use a reverse osmosis system in a batch treatment mode. Such a system involves recirculation of the partially treated water back into the feed tank, causing the water to heat up. The water can be cooled using one of two systems: (1) a single-pass heat exchanger or (2) a closed-loop heat exchange system (CL). The single-pass system, good for 3 years, requires a small chiller costing \$920 plus stainless steel tubing, connectors, valves, etc., costing \$360. The cost of water, treatment charges, electricity, etc., will be \$3.10 per hour. The closed-loop system will cost \$3,850 to buy, will have a useful life of 5 years, and will cost \$1.28 per hour to operate. The interest rate is 10% per year, and the salvage values are negligible. What is the minimum number of hours per year that the cooling system must be used in order to justify purchase of the closed-loop system?

**Break even analysis – production level with cost/revenue the same – no profits or losses. Annual worth the same for two options at certain production level**

$$(920 + 360)(A/P, 10\%, 3) + 3.1x = 3850(A/P, 10\%, 5) + 1.28x$$

$$(920 + 360)(0.4021) + 1.82x = 3850(0.2637)$$

$$1.82x = 1015.245 - 514.688$$

$$X = 500.557/1.82$$

$$X = 275 \text{ hours/year}$$

3. \_\_\_\_\_ [25 points]

[Use Excel built-in function(s) and include in the Excel file only.]

Sundance Detective Agency purchased new surveillance equipment with the following estimates. *Note:* The year index is  $n = 1, 2, 3, \dots$  to calculate the maintenance costs and extra revenues for the corresponding years.

First cost (\$)	1,050
Annual maintenance cost (\$ in year $n$ )	$70 + 5n$
Extra revenue (\$ in year $n$ )	$200 + 50n$
Salvage value (\$ at the end of the useful life)	600

- (a) [20 points] Prepare a cash-flow (CF) table, do present worth (PW) analysis using an appropriate Excel built-in function to calculate the discounted payback period  $x$  with a return of 10% per year.
- (b) [5 points] For a preliminary conclusion, should the equipment be purchased if the actual useful life is 7 years? Comment.

4. \_\_\_\_\_ [25 points]

[Include in the Excel file only.]

The capital fund for research project investment at a corporation is limited to \$100,000 for next year. The company uses an MARR of 15% per year. There are three independent project proposals (i.e., none, one or more can be selected) with pertinent information given in the below table.

Project	Initial Investment (\$)	Annual Net Cash Flow (\$/year)	Life (years)	Salvage Value (\$)
A	-25,000	6,000	4	4,000
B	-30,000	9,000	4	-1,000
C	-50,000	15,000	4	20,000

- (a) [10 points] Formulate the mutually-exclusive alternatives (i.e., bundles) without calculating any worth. Which of the mutually-exclusive alternatives are feasible? Comment.
- (b) [15 points] Use the Excel built-in function NPV to perform a PW analysis for selection and comment.