

National Exams December 2015  
11-CS-1, Engineering Economics  
3 hours Duration

**NOTES:**

1. Assumptions could be made about questions that are not clear to the candidate, but that should be stated clearly.
2. Candidates are urged to draw cash flow diagrams whenever applicable.
3. Any non-communicating calculator is permitted. This is an open book exam.
4. Any four out of the five questions constitute a complete exam paper. Only the first four questions, as they appear in the answer book, will be marked.
5. Each question is of equal value.

## QUESTION 1

CFI Inc., in York County currently studying the following two potential investments: the first investment pays 2% interest per month, compounded monthly, while the second pays 6% interest per 3 months, compounded quarterly.

- Determine the effective quarterly interest rate for each of the two investments. (8 Marks)
- Determine the effective annual interest rate for each of the two investments. (8 Marks)
- Which investment should CFI Inc. choose? (3 Marks)
- How much should the interest rate be (per month, compounded monthly) for the first investment so that neither of the two investments is preferred over the other after one year of investment? (6 Marks)

## QUESTION 2

A Canadian University in the western region is planning to build a new football stadium to solve the capacity problem it has with the current stadium. The construction will start in 2020 and is planned to take four years at a cost of \$10 million per year. After construction is completed, the cost of operation, maintenance and repairs is expected to be \$2 million for the first year, and to increase by 1% per year thereafter. Major overhauling (major repair) for the stadium is to take place during the year 2045 at a cost of \$8 million. The salvage/scrap value of the stadium at the end of year 2068 is estimated at \$15 million. Consider the present to be the end of 2015/beginning of 2016 and the interest rate to be 6%.

- Draw a cash flow diagram for this project (from present till end of year 2068). (8 Marks)
- Find the Present Worth of this project. (10 Marks)
- Find the Future Worth of this project. (Hint: make use of the PW calculated in b). (7 Marks)

## QUESTION 3

A steel fabrication plant in Southern Ontario is studying a replacement decision for its old laser cutter, purchased 7 years ago at \$130,000, with a new more precise laser cutter. Based on market studies, the old laser cutter will have to be replaced some time before the end of the fourth year. The market value of the old laser cutter is currently estimated at \$49,000. Other related data for the old laser cutter are summarized in the table below. The MARR is 10%.

Remaining service life in years	Salvage value (\$)	Operating and maintenance cost (\$)
0	49,000	
1	31,500	17,000
2	19,875	21,320
3	15,656	26,806
4	6,742	33,774

- Determine the EAC (Equivalent Annual Cost) for the old laser cutter over one year, two years, three years and four years of remaining service life. (12 Marks)
- Determine the remaining economic life of the old laser cutter (5 Marks)
- If the EAC of the new laser cutter is \$35,000, should the plant replace the old cutter with the new one now? (5 Marks)
- What could be considered as a “sunk cost” in this example? (Hint: no calculations are needed) (3 Marks)

## QUESTION 4

Three projects are being studied by Green Enterprise Limited. The table below summarizes estimated cash flows for each of the three projects over the next five years. Due to budget limitations, Green Enterprise will only choose one project out of the three projects. At a MARR (Minimum Acceptable Rate of Return) of 12%, answer the following.

Project	Initial Cost	Expenses per Year	Return at end of year 5
1	\$250,000	\$75,000	\$1,000,000
2	\$350,000	\$100,000	\$1,450,000
3	\$450,000	\$150,000	\$1,900,000

- Use a rate of return method to find the economically best project for Green Enterprise (12 Marks)
- Is it expected to obtain different results if the comparison is based on Annual Worth? (Hint: no calculations are needed) (5 Marks)
- Is it always necessary for the alternative with the highest rate of return to be the best alternative? (5 Marks)
- What are the case(s) in which a rate of return method is recommended? (3 Marks)

## QUESTION 5

RTCI Plastics Co. is choosing between two hydraulic injection press models for its plastic production plant in Mississauga. The company has a MARR (Minimum Acceptable Rate of Return) of 9%. Salvage value for both presses at the end of their service lives is expected at \$75,000. Answer the following questions using the information in the table below.

	Press A	Press B
Down payment	\$300,000	\$350,000
Annual Instalment	\$4,500	\$3,500
Maintenance/Repair cost	\$1,500 for the first year, increasing by \$200/year thereafter	\$1,000 for the first year, increasing by \$150/year thereafter
Annual operating cost	\$3,000	\$2,000
Press service Life	20 years	25 years

- State the assumption needed in comparing mutually exclusive alternatives of different lives. (4 Marks)
- Using Annual Worth comparison, which injection press model should be selected? (6 Marks)
- Using Present Worth comparison, which injection press model should be selected? (6 Marks)
- Do both methods (Present Worth and Annual Worth) always yield to the same decision? (3 Marks)
- For a twenty-year study period, what salvage value for press B would make it a better choice? (6 Marks)