

National Exams Dec 2017
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

Consider the following situation;

- What is the return in lending a \$1000 for 3 years at 10% per year simple interest? **(6 Marks)**
- A credit card company charges a nominal 24% interest on the overdue accounts, compounded daily. What is the effective interest rate? (Assume 1 year is 365 days) **(6 Marks)**
- A new investment is expected to make a return of a nominal interest of 40%, compounded continuously. What is the effective interest rate you could earn by this investment? **(6 Marks)**
- The repair costs of a copy machine is expected to increase by \$500 every six months over the next four years, starting with \$500 now. What is the present worth of the repair costs if the interest rate is 12% compounded monthly? **(7 Marks)**

QUESTION 2

The province of Ontario is planning to construct a new hydropower plant to help make energy prices more affordable, as well as to support improved public health and environmental quality. The construction of the hydropower plant will start by the beginning of 2023 and will take 3 years at a cost of \$200 million per year. The cost of maintenance and repairs, which is to start after project completion, is expected to be \$5 million for the first 6 years, and to increase by \$50,000 per year thereafter. The scrap value of the hydropower plant is estimated to be \$25 million at the end of its service life. The project is expected to save the province \$55 million per year in energy savings. Assume the present to be the end of 2017/beginning of 2018, the life of the project is till the end of year 2060, and the interest rate to be 5%.

- Draw a cash flow diagram for this project (from present till 2060). **(7 Marks)**
- What is the Present Worth of the project? **(8 Marks)**
- What is the Future Worth of the project? **(7 Marks)**
- Is it a good investment for the province to make? **(3 Marks)**

QUESTION 3

A medium size assembly plant is considering re-designing one of its assembly stations. The station is currently operated by 2 assembly labors. Due to the complexity of the task, fully automating the assembly station is not achievable. However, it is possible to replace one of the labors with a collaborative robot that can work safely along with the other labor. The plant has a MARR (Minimum Acceptable Rate of Return) of 7%. The table below summarizes the cost for one labor and the cost for one collaborative robot. Use the information in the table to answer the following questions.

	Labor	Collaborative Robot
Purchase price of collaborative robot	-	\$90,000
Robot installation and first-time programming	-	\$10,000
Labor salary/year	\$30,000	-
Benefits for labor/year	\$2,000	-
Cost of robot re-programming	-	\$8,000
Planning horizon	5years	

- If the assembly operation is to be re-programmed every year, is it an economic decision to replace one labor with a collaborative robot? (Use Present Worth) **(6 Marks)**
- If the assembly operation is to be re-programmed every 2 years, is it an economic decision to replace one labor with a collaborative robot? (Use Present Worth) **(7 Marks)**
- Redo question a) using Annual Worth instead of Present Worth **(7 Marks)**
- Do both methods (Present Worth and Annual Worth) always lead to the same decision? **(5 Marks)**

QUESTION 4

A sheet metal fabrication plant in Southern Ontario is studying a replacement decision for its old hydraulic press, purchased 7 years ago at \$130,000, with a new more powerful press. Based on market studies, the old press will have to be replaced some time before the end of the fourth year due to inefficiency. The market value of the old press is currently estimated at \$49,000. Other related data for the old press 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 press over one year, two years, three years and four years of remaining service life (12 Marks)
- Determine the remaining economic life of the old press (5 Marks)
- If the EAC of the new press is \$35,000, should the plant replace the old press with the new one now? (5 Marks)
- What could be considered a “sunk cost” in this example? (Hint: no calculations are needed) (3 Marks)

QUESTION 5

Three investments are being studied by Bright Star Construction Limited. The table below provides the estimated cash flow for each of the three investments over the next five years. Due to budget constraints, Bright Star can only select one investment out of the three investments. At a MARR (Minimum Acceptable Rate of Return) of 12%, answer the following.

Investment	Initial Cost	Expenses per Year	Return at end of year 5
1	\$9,000,000	\$3,000,000	\$38,000,000
2	\$5,000,000	\$1,500,000	\$20,000,000
3	\$7,000,000	\$2,000,000	\$29,000,000

- Use a rate of return method to determine the economically best investment for Bright Star (12 Marks)
- Are you expecting different results if the comparison is based on Annual Worth? (Hint: no calculations are needed) (5 Marks)
- What are the case(s) in which a rate of return method is recommended? (3 Marks)
- Is it always necessary for the alternative with the highest rate of return to be the best alternative? (5 Marks)