

National Exams May 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

A group of young entrepreneurs are looking for a financing loan for their startup company. They are comparing between three different financing companies to choose from. Company A charges 10% compounded daily, company B charges 10.25% compounded weekly, and company C charges 10.5% compounded monthly. (Hint: 1 year could be 366 or 52 weeks)

- Find the effective annual interest rate charged by each of the three financing companies **(8 Marks)**
- Find the effective quarterly interest rate charged by each of the three companies **(8 Marks)**
- Which financing company should be chosen? **(3 Marks)**
- How much should the interest rate be for company A in order to break-even with company B **(6 Marks)**

QUESTION 2

The province of Quebec is planning to build a new hydropower generating station. Building the station will start in 2023 and is planned to take 3 years at a cost of \$75 million per year. After project completion, the cost of maintenance and repairs is expected to be \$5 million for the first year, and to increase by \$50,000 per year thereafter. Major overhauling (major maintenance) for the station is to take place during the year 2045 at a cost of \$10 million. The salvage/scrap value of the station at the end of year 2060 is estimated to be \$15 million. The new hydropower station is anticipated to save the province \$22.5 million per year. Consider the present to be the end of 2016/beginning of 2017 and the interest rate to be 6%. Please note that all expenses or savings that happen during a given year are considered as to take place, on the cash flow, at the end of the year.

- Draw a cash flow diagram for this project (from present till end of year 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 metal fabrication company in Ontario is planning to expand its forming operations. The engineering department is choosing between two heavy duty stamping presses (Press X, or Y). 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 \$300,000. Answer the following questions using the information in the table below.

	Press X	Press Y
Down payment	\$1,200,000	\$1,400,000
Annual Installment	\$18,000	\$14,000
Maintenance cost	\$6000 for the first year, increasing by \$800/year thereafter	\$4,000 for the first year, increasing by \$600/year thereafter
Running cost per year	\$12,000	\$8,000
Service Life	20 years	25 years

- What is the assumption needed in comparing mutually exclusive alternatives of different lives? **(4 Marks)**
- Based on Annual Worth comparison, which alternative should be selected? **(6 Marks)**
- Based on Present Worth comparison, which alternative 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 Y would make it a better choice? **(6 Marks)**

QUESTION 4

A commuter in the Great Toronto Area is choosing between two commuting cars of comparable sizes. The first is a traditional **gasoline car** and the second is an **all-electric car**. Anticipated usage by the commuter is 20,000 km per year. The market value for both cars decreases by 10% per year (Declining Balance Depreciation). Given the data in the table below and assuming that paying will be in cash, answer the following at 0% interest rate.

	Gasoline car	All-electric car
Price	\$24,000	\$36,000
Consumption	6.5 liters per 100 km	12 kWh per 100 km
Fuel/Energy Price	\$0.85 per liter	\$0.14 per kWh

- If the commuter is going to resell the car after 3 years, which car model is more economic? (7 Marks)
- What gas price would justify the all-electric model, over the gasoline model, if the commuter will resell the car after 4 years? (9 Marks)
- How many years of usage will justify buying the all-electric model? (Hint: the answer could be a fraction value). (9 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. (12Marks)
- 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)