

**National Exams May 2016**  
**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

Three Canadian banks A, B and C, each offers a different effective interest rate on its saving account. The following table provides the nominal interest rate offered by each bank along with the compounding period. (Hint: Assume 1 year to be 366 days).

Bank	Nominal Interest Rate	Compounding Period
A	8.25%	daily
B	8.25%	Monthly
C	8.30%	Quarterly

- For each of the three banks, find the effective semi-annual interest rate. (7 Marks)
- Which bank would you prefer to invest your money in? With that bank, how much interest would you get after 3 years on \$5,000 deposit made now? (7 Marks)
- What is the nominal interest rate for a bank that offers 1.4% interest rate every two months? (4 Marks)
- Considering a new option (bank D) that offers 9% **simple** interest rate, would you prefer that bank over the one you chose in b) to make an investment now and have the return in 3 years? (7 Marks)

## QUESTION 2

Southern Ontario is planning to build a new solar power station. The project will start in 2023 and is planned to take 3 years at a cost of \$150 million per year. After project completion, the cost of maintenance and repairs is expected to be \$10 million for the first year, and to increase by \$100,000 per year thereafter. The salvage/scrap value of the station at the end of year 2060 is estimated to be \$30 million. The new solar station is expected to save the city \$45 million per year. Consider the present to be the end of 2016/beginning of 2017 and the interest rate to be 6%.

- 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 city to make? (3 Marks)

## QUESTION 3

Two car models of the same brand are available for consumers in the Canadian market. The price for the **gasoline model** is at \$20,000, and the **hybrid model** (gasoline engine and an electric motor) is at \$24,000. A new buyer is choosing between the two car models. Estimated car usage by the new buyer is 20,000 km per year. The gasoline model has a fuel consumption rate of 6.5 liters per 100 km, while the hybrid model has a better fuel consumption of 4.5 liters per 100 km. The market value for both models decreases by 10% per year (Declining Balance Depreciation). Assuming a constant gasoline price per liter of \$0.75 and assuming the buyer will pay in cash, answer the following at 0% interest rate.

- If the new buyer is going to resell the car after 3 years, which car model is more economic? (7 Marks)
- How many years of usage would justify buying the hybrid model? (9 Marks)
- What gasoline price would justify the hybrid model if the new buyer will resell it after 5 years? (9 Marks)

#### QUESTION 4

A small engineering office in Ontario is considering buying a 3-D printing machine. The office is choosing between two 3-D printing machines that use Fused Deposition Modeling (FDM) technology. The office has a MARR (Minimum Acceptable Rate of Return) of 7%. The salvage value for both machines at the end of their service lives is expected to be \$400. Use the information in the table below to answer the following questions.

	Machine A	Machine B
Price	\$6,400	\$4,400
Running cost per year	\$1,200	\$1,400
Maintenance cost	\$600 for the first year, increasing by \$100/year thereafter	\$400 for the first year, increasing by \$140/year thereafter
Life	6 years	4 years

- State the necessary assumption to compare mutually exclusive alternatives of different lives. (4 Marks)
- Which alternative is more economic based on Annual Worth comparison? (6 Marks)
- Which alternative is more economic based on Present Worth comparison? (6 Marks)
- For a four-year study period, what salvage value for machine A would make it the preferred choice? (6 Marks)
- Do both methods (Present Worth and Annual Worth) always yield to the same decision? (3 Marks)

#### QUESTION 5

A mid-size financial group in British Columbia is studying three investment options. The table below summarizes estimated cash flows for each of the three options over the next 5 years. The financial group is planning to choose only one investment option out of the three options. The MARR (Minimum Acceptable Rate of Return) for the financial group is 12%.

Investment Option	Initial Payment	Payments per Year	Return at End of Year 5
1	\$500,000	\$150,000	\$2,000,000
2	\$700,000	\$200,000	\$2,900,000
3	\$900,000	\$300,000	\$3,800,000

- Use a rate of return method to find the economically best option for the financial group. (12 Marks)
- If the comparison is based on Annual Worth, do you expect different results? (Hint: no calculations are needed). (5 Marks)
- Is it always necessary for the investment option with the highest rate of return to be the best option? (5 Marks)
- What are the case(s) in which a rate of return method is recommended? (3 Marks)