National Exams Dec 2019
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. Please answer the exam questions in the correct order.
3. Please start each question in a new page.
4. Candidates are urged to draw cash flow diagrams whenever applicable.
5. Any non-communicating calculator is permitted. This is an open book exam.
6. 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.
7. Each question is of equal value.

QUESTION 1

a) If you were to lend $700 for three years at 12% per year simple interest, how much interest would you get at the end of the three years? **(6 Marks)**

b) How much is accumulated over ten years on a deposit of $500 today at 10% compounded annually? **(6 Marks)**

c) If your 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)**

d) How long will it take any invested amount of money to double itself, with an 11% interest rate, compounded continuously? **(7 Marks)**

QUESTION 2

A University in the western region of Canada is planning to build a new football stadium to solve the capacity problem it has with the current stadium. The construction will start in 2024 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 2049 at a cost of $8 million. The salvage/scrap value of the stadium at the end of year 2072 is estimated at $15 million. Consider the present to be the end of 2019/beginning of 2020 and the interest rate to be 6%.

a) Draw a cash flow diagram for this project (from present till end of year 2072). **(8 Marks)**

b) Find the Present Worth of this project. **(10 Marks)**

c) Find is the Future Worth of this project. (Hint: make use of the PW calculated in b). **(7 Marks)**

QUESTION 3

Three investments are being evaluated by a local financial corporation in Manitoba. The table below summarizes expected cash flows for each of the three investments over the next seven years. Due to budget limitations, the corporation will only choose one investment out of the three investments. At a MARR (Minimum Acceptable Rate of Return) of 8%, answer the following.

Investment	Initial Cost	Expenses per Year	Return at end of year 7
1	$100,000	$40,000 for the first year, increasing by $2,000 per year thereafter	$600,000
2	$360,000	$85,000 for the first year, increasing by $4,000 per year thereafter	$1,600,000
3	$185,000	$55,000 for the first year, increasing by $3,000 per year thereafter	$850,000

a) Determine the economically best investment for the corporation using a rate of return method. **(14Marks)**

b) Is it always the case for the alternative with the highest rate of return to be the economically best alternative? **(5 Marks)**

c) Are you expecting different results if the comparison is based on Future Worth? (Hint: no calculations are needed). **(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

a) If the commuter is going to resell the car after 3 years, which car model is more economic? **(7 Marks)**
b) 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)**
c) How many years of usage will justify buying the all-electric model? (Hint: the answer could be a fraction value). **(9 Marks)**

QUESTION 5

A sheet metal fabrication plant in the province of Quebec is studying a replacement decision for its old laser cutting machine, purchased 7 years ago at $130,000, with a new more precise laser cutting machine. Based on market studies, the old laser cutting machine will have to be replaced some time before the end of the fourth year (from now). The market value of the old laser cutting machine is currently estimated at $49,000. Other related data for the old laser cutting machine 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

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

End of Exam