

ORDRE DES INGÉNIEURS DU QUÉBEC  
NOVEMBER 2021 SESSION

Open-book examination

Calculators : only authorized models

Duration : 3 hours

14-EC-1 Engineering Economics

Question 1:	15
Question 2:	20
Question 3:	20
Question 4:	15
Question 5:	15
Question 6:	15
Total	100

**Question 1 (15 points):**

You work as an engineer at AICOIN Inc. The company asks you to evaluate the profitability of a wind power project in which it intends to invest. The business has already estimated the cash flows it can reasonably expect from this investment for the next few years. In addition, AICOIN Inc. uses a minimum acceptable rate of return (**MARR**) of **7% compounded monthly (7%; 12)** for its investments and the cash flow is concentrated at the end of the period every **three months**.

Please calculate the net present value (NPV)

Quarter	Cash flow ( in thousands of \$)
0	-1 500
1	400
2	300
3	200
4	100
5	-250
6	-250
7	-250
8	-250
9	-250
10	-250
11	300
12	300
13	300
14	300
15	300

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**Question 2 (20 points):**

You are the chief engineer of the TELACOM printer's department and you carry out the economic study of the project to purchase a new automated press with a purchase price of \$2 million. Delivery and installation costs are \$150,000. The recovery value of this equipment is estimated at \$650,000 in 5 years i.e. at the end of its economic life. The use of this equipment will result in a large 5-year printing contract, which will generate revenues of \$800,000 per year and operating expenses of \$100,000 per year for each year of the contract.

The purchase of this equipment will lead to a tax-deductible depreciation (CCA: Capital cost allowance) of \$300,000 per year.

Given that TELACOM is taxed at a 40% rate per year and uses a 16% effective MARR (minimum acceptable rate of return) for this project, based on the present value (NPV: net present value) criterion, is this project financially profitable?

**Note1:** The net after-tax cash flow year by year is required to develop your answer.

**Note 2:** For this question, assume that inflation does not exist.

**Question 3 (20 points):**

Polyplast, a company that specializes in polymers wants to launch a new product line. In order to do this, two choices are currently being studied: use a thermoformer they already own or outsource the manufacturing to an Asian company. Both options would provide the same revenue increase. The data on the two options are as follows:

1. Instead of selling it, the company can use its thermoformer purchased 2 years ago at a cost of \$56,000. It is estimated that its current value is \$50,000, that its economic life will be an additional 10 years and that its salvage value, in 10 years, will be \$20,000. The allowable depreciation (CCA) is \$3,000 per year. The estimated maintenance and operating expenses are \$20,000 per year.
2. The other option is to sell the thermoformer and sign a sub-contract with a cost of \$39,500 per year.

The company wants a MARR of 12%, its tax rate is 30% and plans a project duration of 10 years. Under these conditions, which option should it choose according to the NPV?

**Note1:** The net after-tax cash flow year by year is required to develop your answer.

**Note 2:** For this question, assume that inflation does not exist.

**Question 4 (15 points):**

TOYTEK Inc. is a toy manufacturing and distribution company for children of all ages. Searching for a viable business opportunity, the company is currently analyzing three independent projects of the same nature in terms of risk. All data represent net cash flows.

Year	TIC	TAC	TOE
0	(250 000 \$)	(200 000 \$)	(300 000 \$)
1	100 000 \$	60 000 \$	90 000 \$
2	90 000 \$	60 000 \$	90 000 \$
3	80 000 \$	0 \$	90 000 \$
4	70 000 \$	60 000 \$	90 000 \$
5	60 000 \$	60 000 \$	90 000 \$
6	50 000 \$	60 000 \$	90 000 \$
7	40 000 \$	60 000 \$	90 000 \$

Knowing that the discount rate (MARR) is 18% for each project, find the missing data in the table below and determine the best project to do.

**Note 1:** For this question, assume that inflation does not exist.

	TIC	TAC	TOE
<b>Net present value (NPV)</b>			43 037 \$
<b>Internal rate of return (IRR)</b>	24,70%	16,64%	
<b>Payback</b>	2,75		3,33

**Question 5 (15 points):**

Your spouse has wanted to move into a new residence for some time so you have decided to buy a new property. The price of your dream house is \$400,000. For some time, you have planned the move and have raised a down payment of \$150,000. Thus, you need a mortgage of \$250,000.

BMA Bank agrees to grant this loan under the following conditions:

- The amount of the loan is \$250,000;
- The interest rate is 2.50% capitalized semi-annually and fixed for 5 years;
- The maturity of the mortgage is 20 years and the mortgage will be renegotiated in 5 years;
- The mortgage payments will be equal, on a monthly basis and at the end of each month;

**5.1** What will be your monthly payment for the first 5 years of the loan? **(5 points)**

**5.2** Determine what will be the balance of the mortgage in 5 years. **(5 points)**

**5.3** At the end of the first five years, the economic situation deteriorated to such an extent that you managed to renegotiate your interest rate at a rate of 10.95% (nominal capitalized semi-annually). Determine the new monthly payment if the maturity of the renewed loan is 15 years. **(5 points)**

**Question 6 (15 points):**

You are asked to study the financial viability of a 3-year investment project.

After consulting the main suppliers of this type of equipment, this is the option available to you. The value of the equipment is currently **\$93,000**, the economic life 3 years and the residual value is **\$33,000 (current dollars)** after this period. The annual amortization (CCA) will therefore be **\$20,000 (current dollars)**. In addition, you estimate operating cash flows before amortization and taxes at **\$40,000 (constant dollars)**.

Given that your company is taxed at 35%, uses a 15.5% **current MARR** at an inflation rate of 5%, please calculate the NPV (net present value) of this investment project.

**Note1:** The net after-tax cash flow year by year is required to develop your answer.

**Note 2:** For this question, at your discretion, you can make the solution either in current dollars or in constant dollars.