

ORDRE DES INGÉNIEURS DU QUÉBEC  
SUMMER SESSION 2020

Open-book examination

Calculators : only authorized models

Duration : 3 hours

14-EC-1 Engineering Economics

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

**Question 1 (20 points):**

Metalock inc. is a laser cutting and bending company for metal parts. In order to automate part of its operations, Metalock wishes to integrate collaborative robots into its production. Three options are considered. All data represent net cash flows.

YEAR	Cobot1	Cobot2	Cobot3
0	(1 200 000 \$)	(800 000 \$)	(2 000 000 \$)
1	300 000 \$	240 000 \$	400 000 \$
2	300 000 \$	220 000 \$	450 000 \$
3	300 000 \$	200 000 \$	500 000 \$
4	300 000 \$	180 000 \$	500 000 \$
5	300 000 \$	160 000 \$	500 000 \$
6	300 000 \$	140 000 \$	500 000 \$
7	400 000 \$	120 000 \$	500 000 \$

Knowing that the discount rate (MARR) is **12% nominal capitalized monthly** for each of the projects, 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.

	Cobot1	Cobot2	Cobot3
Net present value (NPV)		46 167 \$	105 208 \$
Internal rate of return (IRR)	17,28%		
Payback	4,00		

<b>Question 2 (20 points):</b>
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A process produces 5 million pounds per year of industrial oil at full capacity, with a sale price of \$ 1.45 per pound. At full capacity, annual direct production costs are \$ 4 million. Fixed production costs are \$ 1.8 million.

**2.1** What is the break-even point? **(5 points)**

**2.2** What is the actual cost price? **(5 points)**

**2.3** Knowing that the company's tax rate is 28%, what is the current potential net profit from this process? **(5 points)**

**2.4** Would it be viable to raise the price to \$ 1.65 a pound if demand drops to 4 million pounds? **(5 points)**

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**Question 3 (20 points):**

As an engineer for the DRISKO Inc. mining company, you are analyzing the acquisition of a new wastewater treatment system whose capital cost is **\$950,000**. The salvage value of this equipment is estimated at **\$ 290,000** at the end of its **3-year** economic life. Using this equipment would result in savings of **\$ 560,000 per year** and operating expenses of **\$ 175,000 per year**.

The purchase of this system gives rise to a **linear** depreciation (CCA), the half-year rule does not apply.

In order to acquire this new system, the company plans to finance the purchase with a **loan of \$ 500,000** repayable over 3 years at an interest rate of 5%. You will find below, the financial amortization schedule for the proposed loan:

N	Payment	Interest	Capital	Balance
0	\$ -	\$ -	\$ -	\$ 500 000
1	\$ 183 604	\$ 25 000	\$ 158 604	\$ 341 396
2	\$ 183 604	\$ 17 070	\$ 166 534	\$ 174 861
3	\$ 183 604	\$ 8 743	\$ 174 861	\$ -

Knowing that this company is **taxed at the rate of 28%** per year, calculate the **net present value (NPV)** of the project considering a minimum acceptable rate of return (MARR) on equity of 16%?

**Note1 :** The free cash flow to equity year by year is required to develop your answer. You must include the impact of funding in the completion of your solution.

<b>Question 4 (20 points):</b>
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Your company is interested in purchasing laser cutting equipment to increase its production capacity.

After consulting the main suppliers of this type of equipment, here is the option available to you. The value of the equipment is currently **\$ 133,000**. The economic life is **4 years** and the residual value is **\$ 53,000 (current dollars)** after this period. The annual amortization (CCA) will therefore be **\$ 20,000 (current dollars)**. In addition, you estimate operating cash flows before depreciation and taxes at **\$ 32,000 (constant dollars)**.

Knowing that your company is taxed at the rate of 25%, that it uses a **current TRAM of 12.2%** and that the inflation rate is 2%, 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.

<b>Question 5 (20 points):</b>
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To finance the purchase of equipment, your company negotiates a loan of \$ 1,600,000.

Here are the terms of the loan:

- The interest rate is 7.50% nominal capitalized quarterly;
- The term of the loan is 10 years;
- The payments will be monthly and equal (end of period);

**5.1** What is your monthly loan payment? **(5 points)**

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

**5.3** Five years after the loan was granted, economic conditions have greatly improved and your bank suggests a new loan at a nominal rate of 4.50% capitalized monthly in order to refinance your loan on a new 5-year term. What will be your new monthly payment? **(5 points)**

**5.4** If a penalty of \$ 15,000 was necessary in order to make the refinancing proposed above, would the said refinancing still be viable? **(5 points)**