ORDRE DES INGÉNIEURS DU QUÉBEC

NOVEMBER 2020 SESSION

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):

A few years ago, you invested in a newly issued bond from the HDmix Company. When issued, this bond had a nominal value of 100,000$, a semi-annual coupon of 4,000$ and a maturity of 20 years. At the time, you paid 86,677.74$.

You have just cashed the 32nd coupon and have the opportunity to resell this bond to the market for 114,650.96$.

Note 1: For this question, do not consider tax.

Answer the following questions:

1.1 When the bond was issued, what was your required return on this bond that justified the price paid of 86,677.74$? **(5 points)**

1.2 What is the current yield required on this bond justifying the price of 114,650.96$? **(5 points)**

1.3 If you sold the bond for 114,650.96$, what is your realized return? **(5 points)**

1.4 Based on your answer above, if inflation over the period of your investment was 1% per semester, what is your actual return? **(5 points)**

Question 2 (20 points):

As part of your role as a plant manager, you must study the profitability of 5 investment projects resulting from the head office continuous improvement program. For all of these projects, the minimum acceptable rate of return (MARR) before tax was set at 13%.

The first project (A) has a duration of 5 years, requires an initial investment of $ 60,000, will have estimated benefits of $ 15,000 for the first year and then increase by 10% per year. No residual value is anticipated at the end of this project.

The second project (B) has a duration of 7 years, requires an initial investment of $ 75,000, will have estimated benefits of $ 17,500 per year. No residual value is anticipated at the end of this project.

The third project (C) has a duration of 3 years, requires an initial investment of $ 85,000, will have estimated benefits of $ 20,000 per year. A residual value of $ 50,000 is expected at the end of this project.

The fourth project (D) has a duration of 10 years, requires an initial investment of $ 120,000, will have losses estimated at $ 40,000 for the first year and then reach profits of $ 30,000 for subsequent years. No residual value is anticipated at the end of this project.

Finally, the fifth project (D) has a perpetual duration, requires an initial investment of $ 105,000, will have estimated benefits of $ 15,000 per year. No residual value is anticipated at the end of this project.

For each of these projects, calculate the net present value this (NPV) and the internal rate of return (IRR). For your answers, please complete the following table:

	A	B	C	D	E
NPV (13%)					
IRR					

Question 3 (20 points):

AurfQua, a company that specializes in manufacturing quartz countertops, wants to launch a new product line that will require the use of a new, highly technological oven. For this new product line, an annual volume of activity of 10,000 square feet is anticipated.

Two manufacturing options are currently being studied by AurfQua:

1. Acquire the new oven at a cost of $ 85,000 and invest $ 5,000 in layout and installation costs. It is estimated that its economic life will be 10 years and its residual value will be $ 30,000. Deductible depreciation (CCA) is $ 10,000 per year. The forecasted fixed manufacturing and operating expenses will be $ 120,000 per year. Variable manufacturing costs will be $ 8 per square foot.

2. The other possibility is to subcontract the manufacturing at the rate of $ 23 per square foot.

3.1 The company currently wants a 10% TRAM, its tax rate is 30% and plans to do this over a 10-year period. Under these conditions, which option should they choose according to the NPV? **(15 points)**

3.2 What is the volume of activity (in square feet) that would make the two options economically equivalent? **(5 points)**

Note1: Year-by-year after-tax cash flow is necessary in developing the solution.
Note 2: For this question, assume that inflation does not exist and assume that the other information (ex: sale price, delivery cost, etc. is the same for both options).

Question 4 (20 points):

To finance the purchase of equipment valued at $ 600,000, you receive the two financing offers below:

Bank A offer:

- The loan amount is $ 500,000;
- The interest rate is 4% nominal capitalized semi-annually;
- Loan term: 5 years
- Payments will be equal and on a monthly basis (end of period);

Bank B offer:

- The loan amount is $ 600,000;
- The interest rate is 5% effective per year;
- Loan term: 6 years
- Payments will be equal and on a weekly basis (end of period);

4.1 What would be your monthly payment for the loan offered by bank A? **(5 points)**

4.2 Still based on this loan, determine what the mortgage loan balance will be in 2 years (24 months). **(5 points)**

4.3 What would be your weekly payment of the loan offered by bank B? **(5 points)**

4.4 List the advantages and disadvantages of the loan offered by bank B. **(5 points)**

Question 5 (20 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 **$136,000,** the economic life **3 years** and the residual value is **$46,000 (current dollars)** after this period. The annual amortization (CCA) will therefore be **$30,000 (current dollars)**. In addition, you estimate operating cash flows before amortization and taxes at **$50,000 (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.