ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2023 SESSION

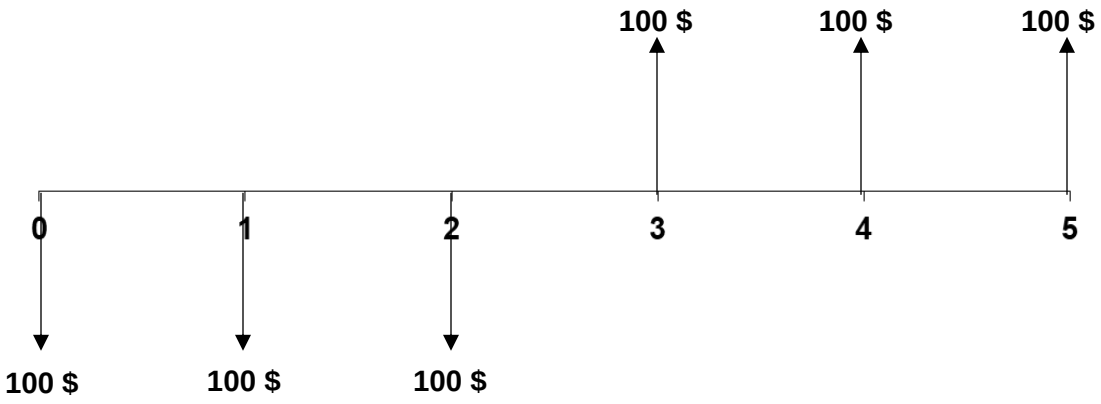
Open-book examination
Calculators: only authorized models
Duration: 3 hours

14-EC-1 Engineering Economics

Question 1 :	10
Question 2 :	10
Question 3 :	20
Question 4 :	20
Question 5 :	20
Question 6 :	20
Total	100

Question 1 (10 points)

a) Consider the following cash flow diagram:



Which of the following equivalence formulas correctly gives the present value of this cash flow (5 points)?

A. P = −100 $ + 100 $ (P/A, i, 5) − 200$ (P/A, i, 2)
B. P = [100 $ (P/A, i, 3)] (P/F, i, 2) − 100$ (P/A, i, 3)
C. P = − 100$ (P/A, i, 5) + [200$ (P/A, i, 3)] (P/F, i, 2)
D. P = − 100$ + 100 (P/A, i, 3) – 100 $ (P/A, i, 2)
E. None of these equivalence formulas are correct.

b) Draw the cash flow diagram whose present value is given by the following equivalence formula (5 points):

P = - 100 + 200 (P/A, i, 2) + [-50 + 200 (P/A, i, 2)] (P/F, i, 3)

Question 2 (10 points)

A little over four years ago you took out 25-year $500,000 mortgage to buy a house. The monthly payments of the loan were computed at a nominal rate of 2.75% per year, compounded monthly and fixed for 5 years. As interest rates have risen lately, your mortgage rate will increase, starting with the 61st payment. If your new mortgage rate is increased to 6.75% nominal per year, compounded monthly, what will be the amount of your new monthly payments?

Note 1: Assume that the balance of the mortgage will be amortized over the remaining of the original term.

Question 3 (20 points)

A wind farm project for the production of electricity with a total capacity of 125 megawatts (MW) is under consideration. The total installed cost of the project is $1,300 per kilowatt (KW). The wind farm will have a useful life of 25 years, after which it is estimated that its salvage value will be approximately equal to the costs of dismantling and rehabilitating the site. Total operation and maintenance costs are estimated at $50 million per year.

If the wind farm operates on average 60% of the time (a year has 8,760 hours) and the minimum annual rate of return (MARR) is 6%, what will be the cost of generating electricity per kilowatt hour (KWh)?

Note 1: For this question, assume there is no inflation
Note 2: For this question do not consider corporate income tax.

Question 4 (20 points)

The Poulin company is considering an investment project for a new model of electric bike.

- The revenues generated by the project would be $450,000 per year for 4 years;
- For this annual sales level, operating expenses would be $ 200,000 per year, excluding depreciation;
- The company will have to acquire equipment at a cost of $800,000. Its salvage value at the end of the project would be $100,000. The capital cost allowance (CCA) rate is 50% per year, with the half-year rule.
- The company will have to invest an amount equal to 20% of annual revenues in its working capital (WC). This investment has to be made at the beginning of the project and will be fully recovered at the end of the project;
- The company plans to finance 40% of its investment in equipment through a loan at the nominal rate of 6% per year, compounded semi-annually, repayable in four year-end equal payments which will include principal and interest.
- The company will be entitled to the small business deduction (SBD), which reduces its tax rate to 13%;
- The minimum acceptable annual rate of return (MARR) for equity financing is 15%.

Should the Poulin company agree to undertake this project? Use the net present value (NPV or NPW) criterion.

Note 1: For this question, assume there is no inflation

Note 2: After-tax cash flow, year by year, is necessary in developing the solution.

Question 5 (20 points)

The ABC Company must choose between two mutually exclusive options (Option A or Option B) for the production of an aircraft part. The company estimates that it could sell 800 units per year of this part for 5 years. Whichever option is chosen, the selling price of the parts would be the same. ABC has the following data:

	Option A	**Option B**
Initial investment	20,000 $	35,000 $
Salvage value	1,000 $	4,000 $
Unit operating costs ($/unit)	5.00 $	2.00 $

a) Based on the annual equivalent cost (AEC) criterion, which option should the ABC Company choose? (15 points)

b) At what annual volume of sales (in units) would the company be indifferent between one or the other option? (5 points)

Use a minimum acceptable rate of return (MARR) of 14% per year.

Note 1: For this question, assume there is no inflation

Note 2: For this question do not take into account corporate income tax.

Question 6 (20 points)

A company is considering investing $150,000 to purchase and install equipment that would generate operating costs savings of $50,000 per year (constant dollars) for three years. The salvage value of the equipment in three years would be $25,000 (constant dollars). The capital cost allowance (CCA) rate for this equipment is 50% with the half-year rule and the company's tax rate is 25%.

If the real rate of return required by the company is 10% and the overall inflation rate for the next 3 years is 7%, is this a profitable project?

Note 1: After-tax cash flow, year by year, is necessary in developing the solution.
Note 2: For this question, at your discretion, you can give your solution either in current dollars or in constant dollars.